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ABSTRACT

Included are brief accounts of the position of science education in 16 countries of the Asian region, providing data on present status, current problems, characteristics of teachers, and curriculum characteristics. Both secondary and primary grades are discussed, and, in some cases, teacher training programs described. An interpretive introduction summarizes trends discerned in the region. Three regional or subregional curriculum development projects are described, and brief summaries of science education projects in the United Kingdom, United States, and Australia provided. A bibliographic supplement contains annotated listings of international and regional conferences related to science education, Asian research studies on science education, Asian documents on education, and relevant UNESCO documents. Text in English; annotations in French and English. (AL)

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SCIENCE EDUCATION IN THE ASIAN REGION

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BULLETIN
OF THE UNESCO REGIONAL OFFICE
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VOLUME IV · NUMBER 1 · SEPTEMBER 1969

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SCIENCE EDUCATION
IN THE
ASIAN REGION

UNESCO - BANGKOK

The exponential growth of scientific knowledge and its power to transform radically man's intellectual and physical environment have led in recent years to a new awareness of the place of science education in the total educational process. The teaching of science has emerged as one of the main areas of curriculum research and development.

The Conference on the Application of Science and Technology to the Development of Asia (CASTASIA)[1] drew attention to the crucial role of science education as "the principal means particularly in the developing countries for transmitting scientific literacy to a broadening stream of population as well as for creating the scientific and technological manpower necessary and indispensable for economic and social advance".

In order to ensure a sound foundation of basic scientific knowledge in the general education of all pupils, the Conference recommended that science should be an integral part of both primary and secondary education and that science teaching should be modernized and improved through well-articulated programmes which would include curriculum research and development, teaching methods and evaluation procedures, teacher preparation, and instructional materials and equipment.

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1. Conference on the Application of Science and Technology to the Development of Asia, New Delhi, 9-20 August 1968. *Final Report. Part I. Conclusions and Recommendations.* Paris, Unesco, 1968. 36 p.

The present issue of the Bulletin presents brief accounts of the position of science education in some countries of the Asian region,* and also of the new programmes that are being developed. As science is universal, so is the current movement in search of new directions in science teaching; therefore of notable interest are the new developments in other parts of the world. Accounts of some of these important and significant programmes are also presented in the Bulletin.

The Unesco Regional Office records its indebtedness to the authors of the articles in the Bulletin for their contributions, and the Ministries of Education and National Commissions for Unesco of Asian Member States for their co-operation in the collection of information and documents.

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* For Member States in the Asian Region, time allotments for all subjects of secondary schools, including science and mathematics subjects, are given in: "General secondary school curriculum in the Asian region," Bulletin of the Unesco Regional Office for Education in Asia, III (2) March 1969.

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SCIENCE EDUCATION IN THE ASIAN REGION

It is widely recognized that science education occupies an important place in the economic development and manpower requirements of Asian countries. Consequently, programmes designed to improve the quality of science education have been launched in all countries of the region; these programmes are concerned not only with the content of science courses taught in schools, but also the way in which it is taught. "Science is not only a body of knowledge; it is a way of thinking and doing, of looking at things and events, an introduction to 'learning how to learn' and as such, the teaching of science and mathematics is a powerful means for developing the attitude of critical inquiry, adaptability and the habit of systematic and hard work which underlie the process of change...." 1/

The new approach to science teaching is therefore closely related to the changes in society from a static to a development orientation. How far changes in school curriculum can be a means of affecting social changes is a moot point. In fact, evidence from history and sociology indicates that changes in education tend to follow rather than precede changes in society. Whether the interest in science education is initiating, or is a consequence of, wider changes, it is certainly a growing interest, as indicated by the literature already available on the subject.2/ It may therefore be expected to have an influence on the school curriculum as a whole. In some countries, in fact, the programmes for science education improvement now have their counterparts in programmes for improving the teaching of humanities and classics subjects.3/

The movement for reform in science education is not just concerned with the improvement in quality of science teaching for the minority of school students who will go on to further studies in science and technology, vital though this minority is. The movement is also concerned with 'science for all', taught in a relevant and interesting way. It therefore embraces science at the first level as well as at the second level, although the former is only beginning to receive comprehensive attention. 4/

The current widespread interest in science teaching reform began somewhat more than ten years ago. Considerable work on new high school science programmes was done in the United States of America 5/ and by the Association for Science Education (then the Science Masters' Association) in the United Kingdom 6/ which later developed into the Nuffield Foundation Science Teaching Project.* Work on similar lines was started in other parts of the world including South America, 7/ Europe, 8/ Australia** and Africa. 9/ In Asia, aims and activities were reviewed at an Expert Conference held in Ceylon in 1963 10/ and, more recently, at a Regional Workshop at Bangkok in 1968. 11/ In addition, national and sub-regional workshops and conferences have been organized by the South-East Asian Ministers of Education Organization (SEAMEO) in connection with its Regional Centre for Education in Science and Mathematics at Penang* and conferences on special aspects of science education held by other organizations including Unesco, the International Atomic Energy Agency (IAEA), and the Asian Association for Biology Education (AABE).**

The AABE publishes quarterly newsletters and the proceedings of its biennial conferences; the Unesco Chemistry Teaching Project* at Bangkok publishes a bi-monthly newsletter as well as other material specifically concerned with chemistry teaching.

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* *Programmes and projects marked with an asterisk are described in this Bulletin.*

** *The first section of the Bibliographical supplement in this issue lists the reports of some international and regional conferences and meetings.*

In the reviews of science education programmes which follow, a number of constraints which place a limit on the rate of progress towards reform, apart from the usual budgetary limitations, are described. These may be listed as follows:

a) Lack of understanding on the part of society of the nature of the scientific process and the aims of modern science education;

b) Built-in traditions regarding the explanation of natural phenomena;

c) Authoritarian attitudes to learning;

d) Need for indigenous research into the learning process;

e) Rigid attitude to examinations, and the limitations that traditional examinations place on curriculum changes;

f) The quality and quantity of available science teachers and supervisors;

g) Lack of material resources for science teaching (both capital and recurring items);

h) The infra-structure (e.g., administrative problems, storage and distribution of equipment, repair and maintenance of equipment and laboratories, lack of technicians, lack of chemicals and biological supplies).

These constraints may be considered under the familiar headings of: curriculum, textbooks, examinations, laboratories and equipment, teacher training and supervision. In considering these items however, it is necessary to take an overall view, and to appreciate their interdependence.

Curriculum

Modern science curricula imply, and in fact require, new attitudes on the part of the teacher and his students. The teacher can no longer depend on his position of authority, nor is he expected to place the same reliance on textbooks. In particular, there are new attitudes to experiences in the classroom and laboratory, and new ways in which interpretations are to be placed on them. The facts of observation and experience are relied upon, but the student is to understand that the ideas and theories about these facts are subject to development and change. Curriculum reform in science education is essentially aiming at making these attitudes a reality for the average child in his rapidly changing society, and has far-reaching psychological and sociological implications.

The search for appropriate content and methods is a long-term, continuous process. Initiation of science curriculum reform in Asia has come from various sources, including the educational administration, universities, teacher-training establishments, and school teachers themselves. In almost all cases, however, authorization of the curriculum comes from the central Ministry or Department of Education. In fact, some countries now have a curriculum development unit attached to their central education authority, and this is becoming the general rule.

The science curriculum reform projects developed in other countries have had an influence on the curriculum reform movement in Asian countries. In some cases these projects have been adopted, with translation into the national language where appropriate. In other cases a foreign project has been adapted and modified according to the needs of the local situation; in yet other cases foreign projects have been carefully studied, but essentially indigenous science education programmes have been prepared. 12/

There is a general awareness of the desirability of relating science courses to applications in industry, agriculture and health. There is, however, plenty of scope for research and development to take into consideration the national needs in science education programmes.

In all countries in the region, science is taught at the first level of education, although in the earlier grades this is often 'nature study'. There is a growing appreciation of the importance of science education at this level, not only for providing a suitable background for students whether or not they continue to take any further formal education, but also the value of science itself as a means of education. There is increasing realization of the significance of the child's environment as a means of developing scientific awareness and an understanding of the basic processes of science.

At the lower stage of the second level, most countries continue with one, two, or three years of general science, but are moving towards greater integration of the separate major disciplines (physics, chemistry, biology) in this subject, often with the inclusion of some earth and space science. With regard to the separate disciplines at the upper stage of the second level, two patterns are followed. In some cases all three major disciplines are studied concurrently, while in others the subjects are studied sequentially. At the lower stage, from 25 to 30 per cent of the total time available is allotted to science and mathematics, of which about half is given to science. At the upper stage, from 25 to 50 per cent of the total time is allotted to science and mathematics, with from half to nearly three fourths of this time for science. [13]

Textbooks

The textbook is being considered increasingly less as a sole source of information for a course. In the newest science education programmes for primary schools, few class texts have been produced which cover the whole course. At the second level of education, there is a diversification of teaching material. A teachers' guide and a laboratory manual for students are provided for most courses and question books, background readers, data books, etc., are complementing, and in some schemes replacing students' class texts.

In practically all the countries of the region, textbooks for use in different stages of the educational system are traditionally authorized by a textbook board, which is generally a unit of the central government. In some countries, the textbook board commissions individual authors (who may or may not be government employees) to write the textbook based on the approved curriculum. Sometimes the commissioning is the result of a competition based on a number of submitted manuscripts. Before approval, the final text may be subject to revision by professionally competent referees or a committee composed of experts in subject matter, and perhaps experts in teaching theory and methods. In some countries this is the end of the process until another manuscript is commissioned, while in others there is some system for feedback and subsequent revision of the texts.

On the other hand, the new science curriculum development projects provide for an organized system for writing the textual materials, usually by committees. These texts are in most cases first produced as experimental editions which are then tried out over a period in selected schools and then revised and re-written. This may be a continuous process.

The system of distribution of textbooks varies; in at least some instances textbooks are distributed to students free of charge.

Examinations

Attempts to reform school science courses can only be effective if examinations, or other procedures used to assess attainment, encourage the kind of study desired. Thus the design of examinations is becoming recognized as a vital part in the process of science curriculum reform. This design requires skill, experience and a clear knowledge not only of the content, but of the aims and the way the science course is taught.

Until recently, examinations have placed a great emphasis on memorization of the course material, but the new science programmes require something more than this. Abilities that are recognizable and measurable by examinations have been listed as follows :

1. An ability to recall information and experience
2. An ability to devise an appropriate scheme and apparatus for solving a practical problem
3. An ability to use and to classify information, including quantitative results

4. An ability to apply previous knowledge and understanding to situations which are quite new and even unexpected
5. An ability to analyze information with evidence of judgement and assessment
6. An ability to report and to comment
7. An awareness of the place of science among school subjects and in the world at large. [14]

In all countries in the region except the Philippines, the terminal examination for secondary education is administered externally by local or national authorities. In Malaysia and Singapore, examinations at this level are also conducted by the Cambridge Examinations Syndicate (U.K.). Thus the re-designing of examinations to match the reform in science curriculum is a difficult organizational process, but one that will have to be accomplished if the various curriculum development projects are to be successful. [15]

Laboratories and Equipment

The expense of adequate provision of laboratories and equipment is an important constraint in the spread of effective science teaching throughout the region, and the emphasis on practical work by students in the new science teaching projects has highlighted this difficulty. Laboratories for primary schools are almost unknown, and in lower secondary schools, where a science laboratory exists, it is generally a combined laboratory designed mainly for demonstrations by the teacher. It is only at the upper secondary level that schools have separate laboratories for physics, chemistry and biology where experiments may be performed by the students, either individually or in groups.

Many school laboratories, however, are modelled on the facilities appropriate for colleges and universities and are unnecessarily expensive. Futhermore, their arrangements with fixed benches and sometimes over-elaborate fittings are more suited to the repetition of standard laboratory exercises rather than the more informal 'open-ended' experiments of the new science teaching projects. The time is therefore appropriate for a thorough review of the design of school laboratories, which should lead to reduction in costs, as well as more efficiency. [16/]

The new science teaching projects also provide an opportunity to re-examine the kind of equipment required for school laboratories. In almost all cases, apparatus is needed which is simpler than the older demonstration equipment, but larger quantities are required so that the students can participate in the experiments. Simple science kits designed for a particular classroom situation are being developed in many countries, and exchange of information between them is likely to lead to further improved designs.

In almost all countries in the region there is still a considerable reliance on the importation of science equipment. Some countries, however, have set up organizations for the manufacture and distribution of school science equipment. In all cases, there is scope for considerable expansion of the schemes. Methods of distribution vary, but in at least one country the equipment is distributed and maintained free of charge within the government system.

Although modern educational technology has produced a variety of teaching aids, problems of infra-structure (e.g. electricity supply, replacement of spare parts, maintenance and repair) have so far restricted very considerably the actual use of modern audio-visual devices.

Teacher Training

Training courses (both pre-service and in-service) for science teachers have at least two functions :

1. The important function of fostering new attitudes, first with respect to the general role and function of the teacher, and then to the teacher's manner of dealing with the new courses in science.

2. The often necessary function of updating and supplementing the scientific background of the teachers.

In most modern science courses, the classroom situation is far less formal than before, and the teacher has to learn not to rely solely on his own authority. Consequently, the courses in the teacher training institutions need to be designed to give the teacher the confidence to handle this new situation.

At the present time, fostering the necessary change in attitude is generally dealt-with by schemes of in-service training. These in-service courses vary in length from one week-end to three months. For the longer courses, teachers may be seconded from their schools and paid salaries, but in at least one country the week-end courses are successfully based on voluntary attendance. While in-service courses will always be necessary, the only long-term solution will come from raising the standard and the level of pre-service training.

Resistance to changes in the science curriculum, as in other subjects, frequently comes from teachers trained on traditional lines; acceptance by students is generally less of a problem. This suggests that the professional preparation of teachers (as in many other occupations in the present-day world) should encourage positive attitudes toward accepting continuous changes in the future.

Supervision

Supervision may be regarded as the key factor in the successful implementation of changes in the science curriculum. Most countries in the region have a system of supervision or inspection of schools, and in some there are a number of supervisors specifically concerned with science teaching.

In some countries, it is clearly appreciated that there must be close co-ordination between the training of science supervisors and the training of teachers. In other countries, however, administrative burdens, transport and budgetary difficulties, and the lack of qualified personnel prevent effective supervision of science teaching in the schools. Nevertheless, particularly where new science teaching programmes are being introduced, there is a need to stress the role of the science supervisor as an adviser and a person to whom the science teacher may go for help, and to move away from the traditional idea of administrative inspection.

Strategy

In initiating reforms in science education, there is a need for concerted action within each country by all the groups concerned in the improvement of science teaching. It is necessary to draw on all available resources, such as : educational administrators, research workers and teachers, university and industrial scientists and technologists, textbook writers, audio-visual aids specialists, broadcasters, and equipment specialists.

The experience with piecemeal efforts, now in the sphere of teacher training, then in textbook production or occasional equipping of school science laboratories, and in superficial revisions to the curriculum by re-arrangement of course content, are coming to be recognized as expensive and futile. The trend is towards adopting a systematic approach, which involves, inter alia :

1. The re-orientation of curriculum development projects and a re-allocation of resources to fit into a comprehensive plan.
2. Pooling the intellectual resources of all agencies for proper planning, execution, evaluation and modification of the plan.
3. Decentralization of implementation.
4. Overall supervision by organizing committees consisting of representatives of all participating agencies and institutions. 17/

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11. Regional Workshop on Unesco/UNICEF-Assisted Projects in Science Education in Asia, Bangkok, 4-18 November 1968. *Planning for science teaching improvement in Asian schools; final report.* Bangkok, Unesco Regional Office for Education in Asia, 1969. 34, xxv p.

12. Projects which have been adopted include PSSC, Chem Study, and IPS. Projects which have been adapted include the BSCS (Green Version) and the Scottish integrated science scheme. (Refer to ref. 5).

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SCIENCE EDUCATION IN AFGHANISTAN

Present status

Science teaching in the primary schools

Although science as such is not taught at the first level, nature study is included in the curriculum of grades IV, V and VI. The first two years of nature study include some simple information on daily life. In the third year, the human body, with information on its care, is studied. The teachers of nature study at this level are usually graduates of either middle school or lycée and are not trained specifically to teach science during teacher training.

There are no science laboratories in the primary schools but, in some schools, collections of improvised equipment and plant and animal specimens are made by thoughtful teachers.

Science teaching in the Secondary Schools

In each of grades VII, VIII and IX (middle schools), three science subjects (physics, chemistry and biology) are taught for two periods per week per subject. In grades X, XI and XII, (lycées) the same three science subjects are taught for three periods per week per subject, except that in grade X geology is taught in place of biology. This means that about 17% of the instructional time in the middle schools and 25% of the instructional time in the lycées is allocated to science for all students.

This article is a condensation of a paper by Dr. Zia Mohamad Fedai, Chairman, Science Department, Institute of Education, Kabul University, Afghanistan.

Teacher training institutions for primary and secondary schools

The Government of Afghanistan has established many institutions for teacher-training, at present operating at four levels.

1. Emergency teacher training: In this programme, grade IX graduates engage in professional training for only one additional year and become teachers for rural schools : grades I through III. When the serious shortage of teachers at this level is met, this type of programme will be discontinued. In grades I-III, no science is taught.

2. Teacher-training institutes which continue to Grade XII : This programme provides training for primary school teachers. There is no special programme for training primary school science teachers. Science is organized differently than in the lycées, however : biology, chemistry, and physics are taught in grades X, XI and XII, respectively, each for about 8 periods per week.

3. Higher teachers training colleges: These institutions provide teachers for the middle schools and have a course for science teachers. Here the graduates of grade XII are given professional training for two additional years. Students selecting the science course study science for 20 periods per week out of a total of 45 periods.

4. Teacher-training in the University: The College of Science of Kabul University trains science teachers for the lycée level. This college has two branches: mathematics and physics; and chemistry and biology. The study period in this college is four years. The greater portion of this time is devoted to subject matter and rather little time to professional studies. The College has never succeeded in providing sufficient numbers of science teachers for the lycées.

A new science teacher-training programme is being inaugurated in the College of Education which will provide for training of lycée teachers in two courses: maths and physics, or biology.

Curriculum and teaching materials

The present science curriculum, especially at secondary level, was developed about twenty years ago. It is based upon European curricula, especially the French. The chart shows the main topics studied in grades VII-XII.

Science textbooks are published by the Ministry of Education and given free to students. The Department makes a contract with a qualified person to write a particular textbook based on the syllabus of the Ministry. The text is then checked by other authorities in the field and, upon their approval, the book is published.

Only the lycées of Afghanistan are equipped with imported sets of physics, chemistry and biology laboratory equipment. In the cities, the middle schools usually make use of the lycée equipment. Among existing laboratories, very few are equipped with running water and none with gas outlets.

Main problems of science teaching

Teaching staff: It has been said that the greatest problem in secondary education is the shortage of qualified teachers. It is very difficult to find a sufficient number of qualified persons to enter the teaching profession. The teaching profession in Afghanistan, as in other countries, has not been able to attract qualified persons because the average annual income in the teaching profession is not satisfactory. 1/ The majority of teachers in Afghanistan are seeking other ways of increasing their income. Most of them teach and tutor as many hours as they can. Therefore, they hardly find time to prepare their lesson plans.

Most science teachers, furthermore, especially in the primary and middle schools, are graduates of the twelfth grade and below and are not trained specifically for science teaching. Generally, the present science teachers have studied science

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1/ This problem is discussed in: Pires, E.A. The recruitment and selection of candidates for primary teacher training in Asia. Bangkok, Unesco, 1968. ii, 86 p. pp. 85-86.

Grade	Physics	Chemistry	Biology (Geology in 10th Grade)
VII	General introduction to mechanics and heat.	Definition of chemistry, water, elements and compounds, symbols and valence, air and its main ingredients, acids.	Study of biology, cell, unicellular organisms, invertebrates and vertebrates, plants.
VIII	General information about sound and light.	General information about metals, the most common metals.	General information about vertebrates, plants (some special families).
IX	General information about magnets and electricity.	General information about organic chemistry.	Animals - insects, worms, parasites, spermatophyta, bryophyta, thallophyta fungi.
X	7th grade programme expanded with mathematical formulae	Matter, chemical laws, water, common gases, halogens, SO_2, H_2SO_4, phosphorus, CO_2, NH_3.	Geology - general information, petroleum, geological periods, rocks and minerals, erosion.
XI	8th grade programme expanded.	Solutions, electrolytes, metals.	Plant physiology.
XII	Wave motions, magnetism, electricity, technical approach.	Organic chemistry.	Animal physiology.

courses as a part of general education, not as special courses for science teachers, although this shortcoming is met to some extent by the present programmes of teacher-training schools. Being trained by lecture methods, the teachers of science are accustomed to giving lectures and placing emphasis on recording and memorization. They pay less attention to demonstration and student experimentation and to the use of local materials. The Ministry of Education has developed plans for working towards changing these conditions.

Use of Science Materials: Although the lycées do have imported sets of equipment, some of the science teachers are not familiar with its use, and do not utilize it fully. Science textbooks, in addition to being of low quality compared to modern science textbooks, have not been available in sufficient quantities. At times, some schools are without science textbooks.

Buildings: Most primary and some secondary schools are operating in rented houses rather than in school buildings. This condition produces a negative effect on all teaching.

Supervision: In the Ministry of Education there are no special science supervisors although qualified persons assigned by the departments do offer some supervision of science teaching.

The Ministry of Education has launched new programmes to cope with these problems. The following section describes some of the plans and efforts developed to meet them.

New developments in the teaching of science

Since 1950, the government of Afghanistan has entered into agreements for assistance in education as well as in many other areas of economic and social development. Among the agreements developed was one with Teachers College, Columbia University (TCCU).

The Institute of Education: The Ministry of Education established in 1954 an Institute of Education where TCCU members and Afghans could work jointly for improvement. The following experimental programmes have been carried out.

Curriculum for the middle school: An experimental middle school, Ebn-i-Seena, was established, where general science is taught for 5-6 periods a week.

The general science programme was designed to be functional in terms of students' and the society's needs. A movement away from lecture teaching and towards activity-centered methods was made. A weekly workshop is held where science teachers of Ebn-i-Seena are helped with teaching problems and presented with explanations of new content and methods. This programme is still operating in Ebn-i-Seena but has only been applied in a few middle schools and emergency teacher training schools.

Establishment of a Maths-Science Lycée Project: In 1965, the Institute of Education, with assistance of the TCCU team, launched another programme for improving and upgrading science instruction at the lycée level: grades X, XI. Six schools were included in the experiment.

Although this project has not brought about any change in the organization of the science teaching pattern in the lycées, it has led to the development of new textbooks for biology and chemistry which differ greatly in content and presentation from traditional textbooks. The translation of an American physics text (PSSC) into the local language was begun, and PSSC laboratory equipment for all six experimental schools has been provided. When the assistance of the cooperating team was discontinued in 1968, the Afghan members of the project decided to continue.

Winter and summer sessions: The Institute of Education, with the assistance of the TCCU team opened the first intensive in-service programmes for upgrading teachers during winter and summer vacations in 1955. In these sessions, hundreds of teachers have received instructional assistance as well as credits. The sessions are now a part of the regular programme of the Ministry of Education.

Science Institutes: To aid the teachers of science and mathematics, the Maths-Science Lycée Project started another in-service programme for secondary school science and mathematics teachers during the summer and winter vacations. Courses are offered in physics, chemistry, biology, and mathematics.

Co-ordination of Activities

A Department of Teacher Training was established about ten years ago in the Ministry of Education, Kabul, to be responsible for the training of teachers for both primary and secondary schools. Unesco assistance is provided at the present time through three main teacher training projects:

1. The Academy for Teacher Educators (see below);
2. The Higher Teachers' College;
3. The Regional Educational Development Project;
4. Regular Teachers' Training Colleges in Kabul and the provinces.

The Department of Teacher Training has steadily expanded its activities; at the moment there are three training colleges in Kabul and seven in the provinces. Its responsibilities cover pre-service and in-service training.

The Academy for Teacher Educators

The Academy for Teacher Educators, Kabul, is a Unesco/UNICEF-assisted project designed to promote the development of primary education in Afghanistan; the science education programme is an essential element in it. The Academy has two main functions: (1) to train the teaching staff for primary teacher training schools in Afghanistan, and (2) to conduct a model teacher training school with practising schools to serve as a pattern for all teacher-training institutions. Older buildings will be replaced by specially designed buildings. A science laboratory and offices, lecture rooms, storage rooms, a library and staff room have all been established.

The stage has now been reached when a steady output of teacher educators can be expected each year. At the same time as the Academy has developed, the government has established teacher training schools in provincial centres. Many of these are very well built with fine dormitories, laboratories, lecture rooms, and practice-teaching schools, much of the equipment being supplied by UNICEF.

In the early 1960s, the Ministry of Education with the assistance of Unesco launched a programme to improve science education in the primary schools. A committee developed a new syllabus for science and a proposal that science be taught in grades I-VI.

Educational broadcasting services are now being planned: the first emphasis will be on training for primary teachers. Many science lessons are to be included in these programmes.

The Higher Teachers' College, Kabul, was established to train middle school teachers. The course offered provides training for either teachers of the Humanities or of the Sciences.

The Regional Educational Development Project is concentrated in particular on the Kandahar and Masar-i-Sharif areas. This project has advisers on science teaching, and special attention is paid to the provision of science teaching aids.

Outstanding Problems

The ultimate success of the programme will depend upon the quality of the teacher educators themselves. Many are reluctant (as in so many other countries) to go out to the provinces to work; it has been proposed that fellowship awards in the future be made to those ready to work in the provinces.

In the teacher-training programme itself, many students look to teacher training not as an end in itself but as an outlet to the university. This is due to the fact that the teacher training course starts in the tenth grade and ends at the twelfth which is the qualifying point of entry to the university. Recommendations have been made that a progressive move be made to provide a teacher-training programme at the post-secondary level, so that students would already have had their opportunity to try for university entrance. A professional one-year course of training would then be provided.

The provision of suitable textbooks (especially of teachers' manuals) will be a continuing preoccupation in the future. Vocabularies in the two national languages are needed.

There is a need to develop the use of simple and inexpensive teaching material from locally available material. There is a good deal of information on this subject available but imagination is needed to make use of it.

The whole approach to education remains distinctly academic and there is great dependence on the textbook and on memorizing facts. The examination plays an excessively important part in the school system. The approach to science teaching can do much to introduce a more practical approach to education and to add an element of work experiences to it.

THE TEACHING OF SCIENCE AT THE BASIC EDUCATION LEVEL IN BURMA

General Background

According to the new Basic Education Act, proclaimed in April 1966, primary education comprises kindergarten and standards one through four, the middle school level consists of classes from the fifth through the eighth standards, and the high school level consists of the ninth and tenth standards. The total is still eleven years from the kindergarten to the tenth standard.

Primary school stage: The primary school stage is sub-divided into the lower and higher primary.

The lower primary stage includes kindergarten, and first and second standards. Here, science is taught as part of environmental studies, together with humanities such as the history of Burma, civics and geography. In this way, students are made to take short excursions and witness for themselves all that is relevant to the subjects they are being taught. No specific textbooks are prescribed and no special equipment necessary. Environmental studies are given 5 periods each week, together with 9 periods (7 in the kindergarten class) of basic mathematics out of a total of 35 periods (of 40 minutes each).

The higher primary school stage comprises the third and fourth standards. In higher primary, the subject matter from chemistry, physics and biology are co-ordinated and taught as basic general science. The most appropriate approach is through the study of nature where, depending on their age and ability, students make relevant observations which have a bearing on the subjects of physics, chemistry and biology. Basic general science is compulsory, and is taught for 3 periods a week, together with 8 periods of basic mathematics out of a total of 35 periods.

This article is a condensation of a paper prepared by the Ministry of Education, Union of Burma.

The teachers in the primary schools have had training in the teaching of subjects which include environmental studies and general science. The teaching aids and equipment required for science are provided-for in the schools.

Middle school stage: Middle school stage comprises the fifth, sixth, seventh and eighth standards. Students are taught general science, with the aim of instilling in the children the habit of making intelligent observations of nature and the environment and, after proper scientific reasoning, drawing appropriate inferences.

Texts prepared according to the approved syllabus include material designed to acquaint the students with scientific principles. Care has been taken to also include exercises to promote the powers of observation, reasoning and retention. The texts also include subject matter relating to the applications of science in increasing productivity; it is hoped that this will be of benefit to those students who decide to take up vocational training after finishing middle school. The syllabus will also benefit those who cannot pursue further education by enabling them to gain a perspective of this scientific age. All students in the middle schools must take general science. General science is studied during five periods of 45 minutes each in all middle school standards (except the fifth: four periods).

In the academic year 1967-68, there were about 563,000 students in middle schools, for which there were 8,666 Junior Assistant Teachers, most of them well enough qualified to teach general science. Laboratories and scientific equipment and teaching aids are needed: of the 888 middle schools in Burma, 300 have adequately equipped laboratories; 77 have partially equipped laboratories and the remaining 511 have no science laboratory at all.

High school stage: High school comprises the ninth and tenth standards. Students are allowed to opt for science subject combinations or arts subject combinations most suited to them. For those taking science combinations, Burmese, English, mathematics, (including algebra, geometry and trigonometry), chemistry and physics are compulsory, and one of among biology, geology and agriculture may be elected.

The subject of geology is a science most intimate to man. The present syllabus was designed to take advantage of this special relationship of the subject to mankind, and includes material to arouse in students a desire to explore the natural surroundings. In the teaching of agriculture, the importance of scientific methods in cultivation and livestock breeding is emphasized.

There are 377 science high schools where all compulsory science subjects are taught. Of these, 280 schools teach biology, 37 schools teach geology and 60 teach agriculture. In all, 300 schools have adequately-equipped science laboratories, while the remaining 77 have laboratories which are only partially equipped. In addition, the student-teacher ratio in the science high schools leaves much room for improvement. There are 96,500 students taking science in the high school, with only 990 science teachers. This adverse student-teacher ratio is mainly brought about by the vast increase in the number of students electing to take up science. It is estimated that recruitment of about 600 additional science teachers, to make up the number required, can be effected by the year 1970.

Teaching Personnel

Primary schools: There are 47,000 Primary Assistant Teachers available for teaching 2,882,000 students in the primary schools. The majority of the Primary Assistant Teachers have passed the School Leaving Certificate Examination and graduated from the State Teachers' Training College, attending a rigorous one year's training course. There are eight State Teacher Training Colleges in Burma, open only to those who have passed the Basic Education High School Examination.

Middle schools: There are 8,600 Junior Assistant Teachers available for teaching a total number of 563,000 middle school students. The majority are matriculates who have successfully completed the prescribed courses at the State Teachers' Training Institutes and have obtained their certificates. Some of the Junior Assistant Teachers have passed the Intermediate of Science or Intermediate of Arts Examinations. Belonging to another category of Junior Assistant Teachers are those who have obtained the Bachelor of Science or Bachelor of Arts degree but have no Junior Assistant Teacher's Certificate.

To obtain the Junior Assistant Teacher's Certificates, matriculates and those who have passed the Basic Education High School Examination may attend a two years' course offered at one of the three State Teacher Training Institutes.

High schools: The majority of the 990 high school science teachers are graduates with B.Sc. degrees. Some of these teachers have obtained diplomas in teaching (D.T.) and some have Bachelor of Education (B.Ed.) degrees. Some of the high school science teachers have had basic grounding in science by completing the I.Sc. course at the university and have obtained their degrees of Bachelor of Arts in Education from the Institute of Education by specialising in science.

For the last three years, refresher courses for Senior Assistant Science Teachers have been organised during the summer holidays at the universities. About 600 Senior Assistant Science Teachers attend these courses annually for reorientation in the various science subjects.

Curriculum and Textbooks

Under the auspices of the Ministry of Education, a committee has been constituted to review the syllabi and to supervise the preparation and publication of school texts. The committee includes all the science professors from the universities, science inspectors from the Directorate of Education and science teachers. Texts prepared must be submitted for edition to the sub-committee concerned and after such edition, forwarded to the syllabi committee for final approval.

A major programme was launched in 1967 for the improvement of science education. To make a success of this programme, the syllabi for all classes were improved and redesigned and appropriate school texts were written and distributed.

Principal problems

When the high schools were reopened immediately after the Second World War, reconstruction of laboratories, and procurement of chemicals and teaching equipment could not be effected immediately. Accordingly, practical demonstrations and classes could not be held for the teaching of science subjects such as general science, chemistry and physics. This unsystematic way of teaching science became a habit, and even after the restoration of facilities, some teachers persisted in their old ways of teaching without demonstration. With the introduction of the new system of education and the accompanying changes in the syllabi and teaching methods, some teachers doubted their ability to teach properly according to the new syllabi. Finally, because of the precedence given to the teaching of science, the number of students taking science has increased tremendously, resulting in a sudden shortage of science teachers, laboratory facilities and equipment.

Programmes for the Improvement of Science Education

To acquaint science teachers with the new methods of approach to the various science subjects and to familiarize them with practical techniques, refresher courses were organized at the universities. These re-orientation courses brought about immediate improvements and the science teachers gained noticeable confidence in their ability to teach according to the new syllabi. Lecture demonstrations in practical techniques and practical classes are now being conducted regularly in the high schools. The number of Teachers' Training Colleges and Institutes has nearly doubled since 1964.

The Production of science teaching equipment

The expenditure incurred by the Education Department for the purchase of laboratory equipment and chemicals for the three years 1965-1967 totalled approximately $1, 244, 000 for all levels.

Most equipment and material for teaching science in the schools are purchased from abroad, but some is locally manufactured. For this purpose, the Burmese Government has set up a scientific instruments centre at the Union of Burma Applied Research Institute and a science workshop at the Rangoon Arts and Science University. The Unesco-UBARI Scientific Instruments Centre Project was started in 1956. The Government of the Union of Burma supplied a new building covering 390 square metres to house the mechanical, glass-blowing and optical workshops, added to an electronics laboratory already existing. Science teaching equipment produced by this centre has been found to be of a sufficiently high standard to be usable in the schools and universities. UNICEF has provided machines and supplementary equipment and raw materials. The Science Workshop of the Rangoon Arts and Science University is also producing some scientific equipment.

SCIENCE TEACHING IN CEYLON

General Background

Since Ceylon gained Independence in 1948, successive Governments have made concerted efforts to provide an education consistent with the emerging socio-economic needs of the country. In the late nineteen fifties, action was initiated in the direction of diversification and quality improvement in secondary education, particularly in the fields of science and mathematics. This entailed the organization of a curricula-revision programme with a view to evolving detailed curricular specifications in the fields of physics, chemistry and biology, for implementation at the General Certificate of Education (Ordinary) Level.

In first level education programmes (age group 5-14 years), the emphasis is placed on the development of the pupil for full community participation and citizenship. Towards the latter part of this programme, teaching of subjects such as first language, second language, and arithmetic are emphasized together with an introduction of certain environmental activities, such as agriculture and general science, with a view to developing desirable basic skills and abilities.

Second level General Education programmes (age-group 15-18 years) have been confined to the teaching of academic subjects. A diversification of the curriculum at this level has been attempted in certain subject areas, such as science, agriculture and industrial arts. The following figures indicate the schools where facilities were available for the teaching of science in 1967.

Schools with Grades 6, 7 and 8 = 1,100
Schools with G.C.E. (O. Level only) = 524
Schools with G.C.E. (O. & A. Levels) = 147

This article is a condensation of a paper prepared by Mr. D. P. Wijegunesekera, Ministry of Education, Ceylon.

Teaching Personnel

The total number of teachers in service in 1967 was 90,515 while another 5,306 were enrolled in 26 teacher training institutions in the Island. An analysis of the present teaching cadre by qualification is indicated below:

Trained graduates or graduates = 6,697
Trained teachers = 35,918
Certificated teachers = 18,332
Non-certificated teachers = 19,839
Specialist teachers (for English, science, maths, industrial arts, etc.) = 2,852
Pupil teachers = 6,877

The Problems

In view of the critical significance of education in economic development, existing education programmes in Ceylon were examined by several Commissions and Committees during the last decade. It has been stated that the uncontrolled expansion of secondary education of an academic nature has hindered the full utilization of the human resources of the nation for its development, leading to educated unemployment and a dearth of skilled workers.

The World Bank, in a preliminary survey 1/ in September 1966, cited limitations as summarized below.

- The system has expanded without consideration of manpower needs or financial resources available. The content is weighted in favour of the humanities and the approach is academic.
- There is a serious shortage of teachers of science and mathematics and of vocational subjects, especially in the Sinhala medium schools.
- The teaching of first and second languages needs strengthening for progress in all other subjects.
- Many primary and junior secondary grades lack even the minimum basic equipment for teaching.

Reforms envisaged

In recognition of these limitations of the education system, a bill entitled "Proposals for Reforms in General and Technical Education" was presented to the Parliament in November 1967, with a view to obtaining parliamentary sanction for the implementation of the following:

- to confine first level education to grades I to VII (ages 5-13) providing universal general education;
- to organize the second level education (grades VIII-XII) in 4 types of schools, providing general and technical/ vocational education.

The second level general education (ages 14-18) will provide courses in agriculture, science, arts, commerce and home science. Grade VIII will serve as a grade of orientation; graded curricular diversification will be attempted at the end of grade X; i.e., G.C.E. Ordinary Level Examination.

In anticipation of these reforms, the Ministry of Education has been divided into 3 major divisions, Elementary, Secondary and Technical Education, each such division being under the control of a Deputy Director General of Education. The Permanent Secretary to the Ministry of Education functions as the Director General of Education. The Island is divided into 15 educational regions comprising 23 educational districts.

The present status of science teaching

Curriculum Revision

The analysis of examination questions in the Science subjects, administered during a period of 10 years up to 1960, revealed that about 90% of the questions called for the mere recall of information on the part of the examinees. Further, heavy repetition was observed, while some areas of content were not tested at all. These examinations have dominated the curriculum, and the method.

In the circumstances, an attempt was made in 1960 to re-examine the objectives of science teaching with a view to evolving detailed curricular specifications in physics, chemistry and biology for implementation at the G.C.E. Ordinary Level, consistent with current trends.

The main objectives of the revision of curriculum in physics, chemistry and biology were as follows:

1. To make these curricula consistent with the emerging socio-economic needs;
2. To develop the teaching with emphasis on the scientific method;
3. To inculcate a scientific attitude in the pupils;
4. To base the teaching on observations and experimentation to develop an understanding of science concepts.

A similar programme of curricular revision was initiated in the field of general science and mathematics, for implementation in grades VI-VIII. The emphasis was on the method of science, rather than on science content.

Textbooks in physics, chemistry and biology have been so designed as to provoke thinking on the part of the pupils. Standard maximum lists of science equipment have been derived from the revised schemes of work in these subjects, and issues of science equipment to schools are made from them. Further, action has been initiated to re-examine the existing schemes of work and syllabuses of instruction in physics, chemistry, biology and zoology available for use at G.C.E. Advanced Level, with a view to effecting revision.

Revised schemes of work in biology have been subjected to a further stage of revision by the School Biology Project, which was initiated with assistance from the Ceylon Association for the Advancement of Science, and the Asia Foundation.

Implementation of curriculum reform

The revised curricular specifications in physics, chemistry and biology are being implemented in about 550 of the 1,300 second-level schools, at the G.C.E. Ordinary Level. In 150 of these schools, programmes have been organized to teach physics, chemistry, biology and zoology at the G.C.E. Advanced Level.

Further, 1,000 first-level schools have been organized for the teaching of general science in grades VI-VIII. Attempts are being made to introduce general science programmes progressively to all the 8,000 first-level schools, to enable the provision of general science as a compulsory subject. In grades IX-XII, specialist science subjects could be offered as optionals.

The 550 secondary schools which have G.C.E. Ordinary Level science programmes are provided with laboratory facilities. The schools which lack G.C.E. (Advanced Level) science programmes are provided with a single laboratory unit each, consisting of a laboratory, lecture theatre and store room. The Advanced Level science teaching schools amounting to 150 schools are provided with 3 separate laboratory units each, for the three subject-areas. Each of these laboratories provides work space for about 30 - 35 pupils at a time.

The annual increases in science enrolment demand the provision of 30 - 35 new science laboratories each year. Thus far, about $2,500,000 has been spent on equipment. Approximately 95% of the science equipment supplied to science teaching schools is imported from overseas. A Science Equipment Production Unit has now been established with a view to producing some of the simple items of equipment, using locally available resources such as sawn timber.

Once a new laboratory is constructed in a second level school, a complete set of G.C.E. science laboratory equipment is supplied to commence the teaching programme. Thereafter, consumable and perishable items of equipment and material are supplied annually to maintain the teaching programmes.

The effective teaching of science necessitates the provision of instructional or resource material such as reference books, textbooks, and periodicals for the use of both teachers and pupils. In this context, the 550 second level schools having science programmes have been provided with such material, depending on the availability of funds.

The general science programmes are conducted in normal class rooms where a few cupboards are provided for the storage of equipment. Simple items of science equipment and material costing about $150 are supplied to each first-level school, to commence the general science teaching programme. The cost of equipment supplied to date is about $200,000.

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Provision of teaching personnel

The science teaching personnel in the Ceylon School System could be broadly classified into the following types, on the basis of their qualification:

Trained graduates: These are graduate teachers in Science, numbering about 320, who have subsequently obtained the Diploma in Education, or a post graduate degree. They are in general assigned to schools with Advanced Level science classes.

Graduates: These are teaching personnel who have obtained a degree in science, but have little professional training as teachers. They number about 610, and are in general assigned to schools for teaching science at the G.C.E. Advanced Level.

Specialist trained: These are teachers with 10 years of general education (G.C.E. Ordinary Level) together with 2 years of training in a teacher training institute. During the 2-year period of training, approximately 2/3 of the time is devoted to a study of science. The number of teachers available amounts to about 1,100.

Untrained teachers: These are teachers with only 10 and 12 years of general education, without any pedagogical training. These teachers (about 600) usually teach general science in grades VI-VIII.

In the science education programme, at the present pace, approximately 30 graduates in science and approximately 50 science-trained teachers would be required annually, once the present staff shortage of about 200 teachers is met.

In-service training

The teacher who is accustomed to traditional science teaching which is highly academic, with little emphasis on pupil observations and experimentation, is most likely to misinterpret the revised courses of study. In this context, various in-service training programmes have been organized, including annual two-week vacation programmes and annual 10-day programmes, the latter being organized with curriculum design staff who have participated in the Nuffield Science Teaching Project in the United Kingdom.

Problems encountered

The maintenance and development of the programme has been handicapped by the following circumstances:

1. Shortage of an adequate science teaching staff;
2. limited foreign exchange, for importation of equipment;
3. shortage of competent teacher educators and supervisors with sufficient professional training;
4. shortage of vehicles for field supervision;
5. negative attitudes toward innovations in science curricula.

Supervision and evaluation

Twenty science supervisors have contributed significantly to the curriculum revision programme, by the reporting of their field experiences to the design staff. This feedback information will be utilized in the next revision.

Since 1964, evaluation reforms have been instituted, consistent with the revised teaching specifications in science. In the middle of 1965, a pilot examination was administered to a sample of pupils in the fields of physics, chemistry and biology, with a view to ascertaining the extent to which the objectives have been achieved. The results of these tests were analyzed to determine the performance characteristics of the test items, such as difficulty index, and discrimination coefficient. 2/

New programmes

Science Equipment Manufacturing Project

The Government of Ceylon established in 1965, at Veyangoda, in the new Science Teacher Training College site, a science equipment manufacturing unit. Production was initiated in 1967 on a pilot scale using local personnel. This project has been divided into three phases, each of approximately 3 to 4 years duration. During the first phase, simple items of science equipment, such as test racks and test tube holders are being produced using sheet metal and sawn timber.

During the second phase, the programme will include the assembly of instruments such as ammeters, voltmeters, and stop clocks, using imported components. Further, the bottling of chemicals, imported in bulk, and filling of thermometers will be attempted during this phase.

The third phase of production envisages a consolidation of the work carried on during the first two phases, together with the production of simple items of glassware apparatus.

The present pilot scale production programme has been initiated with a view to facilitating the training of production staff, to ascertain the nature of the problems encountered in production, and the manner in which these could be resolved.

Curriculum Development Centre project

In recognition of the significance of the curriculum development programme and the limitations encountered in its implementation, the Government of Ceylon made provision for the first-stage construction of a Curriculum Development Centre. The primary objectives of this project are to provide facilities for the organization of a co-ordinated programme of curriculum revision in all subjects of the curriculum, with a view to facilitating central control, guidance and administration, and to provide facilities for educational research and planning. The unit, once established, will enable the Ministry of Education to execute a quality improvement programme.

1/ International Bank for Reconstruction and Development, Washington, D.C. Report on a preliminary reconnaissance survey of education in Ceylon, with comments on projects for aid /Colombo?/ Ministry of Planning and Economic Affairs, 1966. 87 p. pp. i-ii.

2/ Ratnaike, J. "Evaluation - a critical factor in curriculum development - a case study in Ceylon," Bulletin of the Unesco Regional Office for Education in Asia, III (2): 129-139, March 1969.

SCHOOL SCIENCE EDUCATION IN THE REPUBLIC OF CHINA

General Background

In the Republic of China, the prevailing school pattern is the 6-3-3-4 system: six years (grades I-VI, ages 6-12) for the elementary (primary) school, three years (grades VII-IX, ages 13-15) for the junior school, three years (grades X-XII, ages 16-18) for the senior high school, and four years for college, (university)(ages 19-22). After college it takes a student 2-3 years to secure a master's degree and then 2-4 years for a doctor's degree.

There are, however, many exceptions to the standard school system. For instance, there are a number of five-year junior vocational schools which recruit elementary school graduates, five-year junior colleges which admit junior high school graduates, and three-year junior engineering colleges for training technicians and which recruit senior high school graduates for the purpose.

At present there are in the Republic of China 3,361,041 children in schools and colleges out of the present population of 13.3 million people. In other words, one in every four persons is in school or college. According to a survey made by the Taiwan Provincial Department of Education, 97.52% of children of school-age were in attendance in the elementary school during 1966-67. Table I gives a picture of distribution of all teachers and students in the country.

This article is a condensation of a paper by Dr. Cheng-Hsia Wang, Professor of Chemistry, National Taiwan Normal University.

TABLE I : School statistics by level of education
(School year 1966-67, 1st semester)

	No. of Schools	No. of Teachers	No. of Students
Grand Total	3,489	96,296	3,361,041
Higher Education			
University	9	3,064	36,332
College	13	1,612	41,542
Junior College	57	2,883	60,739
Total	79	7,564	138,613
Secondary Education			
High School	458	23,706	640,447
Normal School	6	88	1,570
Vocational School	136	7,065	143,296
Total	600	30,859	785,313
Primary School	2,208	55,683	2,348,218
Kindergarten	602	2,190	88,897

The Government has extended the duration of compulsory education from six to nine years from the beginning of school-year 1968-69. One of the serious hindrances to effective implementation of any improved curricula or teaching methods in the past was the competitive entrance examination for primary school graduates on the results of which admissions were made to junior high schools. The entrance examination system encouraged memorization of facts and inhibited the all-round mental, social, emotional and physical development of the pupil. The nine-year compulsory education will overcome appreciably these limitations. The programme will ensure a normal healthy science education not only within, but also outside the classroom and make it possible for pupils to participate more frequently in activities such as those of the "Association for the Advancement of Natural Science for Young People" sponsored by the Taiwan Provincial Education Association.

The Present Status of Science Education

According to the curriculum standards prescribed by the Ministry of Education, science education should:

1. stimulate pupils to find problems from natural environment, use scientific methods to solve them and develop scientific attitude and mind;

2. encourage pupils to understand natural phenomena and mysteries of science so as to cultivate their interest in study of science;

3. encourage pupils to understand scientific principles and learn to use natural law to solve problems of life and nature; and

4. guide pupils to understand the inter-relationship of life and nature in order that they may use scientific knowledge to adapt and change their life for the better in the present-day world of rapid scientific growth.

Science instruction. Science is taught as a compulsory subject in elementary schools as well as in junior and senior high schools. It is taught as separate disciplines in junior and senior high schools. Primary schools allot 5% of school time to science. In junior high schools, 3% of school time is allocated to biology (7th grade), 4% to chemistry (8th and 9th grades), and 4% to physics (8th and 9th grades). Earth science is an elective subject which occupies 2% of school time in junior high schools. Similarly in senior high schools, 3% of school time is allocated to biology (10th grade), 5% to chemistry (11th grade), and 6% to physics (12th grade) in case of pupils who major in natural science, and 3% each to biology, chemistry, and physics to those who major in social science.

Facilities required to implement the science curriculum are available in all schools in urban and rural areas. Urban schools are, however, financially in a more favourable position and can afford to buy more apparatus and equipment so that pupils can do experiments in smaller groups. In such areas two pupils form a group in high schools, and six pupils in primary schools, to do practical work in science.

Teaching personnel. The minimum educational qualification prescribed by the Government for an elementary school teacher is graduation from a normal school; i.e., 9 years of general education followed by 3 years of integrated general and professional training. Since 1960 the Government has been converting normal schools into normal colleges providing 5 years of integrated general and professional education after nine years' schooling. This has started a flow of better qualified teachers into elementary schools.

The education qualification prescribed by the Government for junior and senior high school teachers is graduation from a normal college or normal university; i.e., 12 years of general education (senior high school graduation) followed by 5 years' integrated general and professional training. About 50% of chemistry, physics, and biology teachers are at present qualified to teach the subjects in high schools.

Curriculum and teaching materials. The Ministry of Education has constituted a Curriculum Development Committee composed of experts on curriculum development, teacher educators, subject specialists, psychologists, practising teachers, and educational administrators. Minimum standards of curriculum in each subject are prepared by the committee and issued by the Ministry of Education. It is significant that curriculum in the Republic of China discarded long ago its narrow traditional concept involving a list of subjects, set out in greater or less detail, which are to be studied by pupils under the teacher's guidance. The country has adopted the broad concept of curriculum consisting of all experiences of pupils which are planned and directed by the school and the teacher to attain the objectives of education.

The curricula now in use in the senior high schools were introduced in 1964 and will continue to be used for the time being. New curricula for all elementary grades and subjects have recently been issued; they were got ready in the record time of less than six months with the assistance of fourteen committees of specialists.

The National Institute for Compilation and Translation is responsible for the preparation of textbooks for elementary and junior high schools. A committee for the compilation of textbooks in each subject has been set up and its members include university professors, subject specialists, educational administrators and practising teachers. The contents of textbooks are well planned and organized. Before they are finalized, they are discussed again by experts. The textbooks prepared are based on the final draft of contents and aim at a high standard of preparation and production. The textbooks (more than a hundred titles) are being prepared according to the new curricula by the National Institute for Compilation and Translation which has commissioned a large number of authors, illustrators and other helpers for the job.

According to a schedule fixed by the Ministry of Education, the entire new curricula, textbooks and teacher's guides will be introduced during the period of four years beginning with the school-year 1968-69. The Ministry of Education has undertaken an experimental study and review of the new curricula and textbooks as they get introduced in the elementary school. The study and review will be spread over a period of six years beginning with the school-year 1968-69 and will be accomplished by the co-operative effort of three groups of people, viz. subject specialists, Junior Normal College personnel and selected teachers from a chosen sample of elementary schools in the country.

Inspection and supervision of science teaching. A team of about 25 supervisors and inspectors of the Provincial Department of Education is entrusted with the primary duty of supervising secondary schools. The team is divided into four groups of 6 or 7 supervisors each, one group being responsible for the supervision of schools in a region of Taiwan (north, middle, south or east). When necessary, high schools may ask the Normal University to send science professors to their schools to supervise science education.

The agencies which are assigned duties of supervision of elementary schools and their respective roles are:

1. 37 supervisors and inspectors of the Provincial Department of Education supervise educational administration of elementary schools in the 22 counties and cities.

2. 10 selected subject teachers forming the provincial supervisory team are required to organize a provincial seminar every year to develop an annual plan of supervision.

3. Nine normal college supervisory units each consisting of 2, 3, or 4 members of the faculty are assigned duties of supervising teaching in the ten regions into which Taiwan is divided for the purpose. They supervise mainly pilot schools set up under a Unesco/UNICEF-assisted education project.

4. Four supervisors, on an average, in each city and county bureau of education are responsible mainly for supervision of school administration.

5. Local supervisory team in each county and city, consisting of 10 to 37 selected principals and teachers of elementary schools undertakes supervision in non-pilot schools.

6. Eight members of the faculty of the National In-service Training Centre at Pan-chiao undertake follow-up supervision of teachers who have received in-service training at the Centre.

The principal problems. It has become urgent and necessary that the Republic of China should set up a centre of science education to take care of all activities in science education in the country. The centre should have a library containing periodicals, science textbooks, new curriculum materials and reference books. A fully equipped research laboratory should be available to teachers as well as students who need facilities to do research in science education. The centre should have classrooms and conference rooms for domestic and international science education activities. It should publish a periodical which will inform science teachers of the latest science teaching materials and results of evaluation of science teaching materials and methods. The centre should, of course, keep itself in touch with all international developments in school science education in general, and with developments in Asia in the subject area, in particular.

Specific Programmes for Improvement of Science Education

Mobile science carts and books for supplementary reading. The most important and rewarding programme currently in progress is the development and distribution of mobile science carts to elementary schools in the country with Unesco/UNICEF assistance. The project is also responsible for another important programme now in progress, viz. the publication of books in science for the supplementary reading of elementary school pupils.

Health education and nutrition. The significance given to health education including nutrition in elementary and high schools deserves special mention as an important aspect of science education in the country. Unlike some other countries where these areas of science and its application are dealt with as a part of the curriculum in general science, the Ministry of Education in the Republic of China has listed health education including nutrition as a separate subject in the curricula of both elementary and junior high schools and has allotted for the subject one hour a week in the school time-schedule.

National science exhibition. The Ministry of Education has been holding national science exhibitions once a year since 1960 with the following objectives:

1. to stimulate pupils' interest in science,
2. to cultivate in them the proper attitude regarding science experiments,
3. to develop their creative thinking in science so as to discover science talent,
4. to provide more opportunities for teachers and pupils to study science and improve teaching methods,
5. to focus the attention of the public on the importance of science and to enlist their cooperation in the development of science education.

Before the national science exhibition, there are pre-exhibitions held in counties and cities. Scientists and experts are invited as judges to select for presentation of awards the best exhibits at pre-exhibitions held in counties and cities. Exhibits are presented by teachers as well as students.

Science clubs. The programme of science clubs in schools in Taiwan which was first started in 1962 with assistance from the Asia Foundation has grown in strength in later years. It has as its objective the encouragement and guidance of pupils in science activities. The programme is directed by the National Taiwan Science Hall, and the Science Club Advisory Committee co-operates closely with the Departments of Elementary and Secondary Education of the Ministry of Education in organizing the clubs.

SCHOOL SCIENCE TEACHING PROGRAMMES AT THE FIRST AND SECOND LEVELS IN INDIA

General Background

The population of India is now well over 500 million: half of this is below the age of 18 years. Over the next 20 years, the population is likely to increase by another 250 million.

In India there are 27 administrative units comprising 17 States and 10 Union Territories. School education is a State subject and is directly managed by these administrative units. The structure of school education varies from State to State. As recommended by the Indian Education Commission (1964-66), many States are now trying to develop a uniform pattern of four years' lower primary school, three years' higher primary school (middle school)and three years' high school. This would be followed by two years of pre-university or higher secondary stage and three years of first degree course in University.

There are at present 387,316 primary schools, 77,260 middle schools (most of them including the primary sections also) and 26,883 secondary schools (most of them including the middle sections also).

There are 214 degree and post-graduate colleges which train teachers for the secondary schools and about 1,200 under-graduate teacher training schools which prepare teachers for the primary and middle classes.

This article is a condensation of a paper by Dr. M. C. Pant, Head of the Science Education Department, National Council of Educational Research and Training, New Delhi.

Science Education

Science at the primary stage. Science at this stage is a compulsory subject and is taught under different names like elementary science, nature study, general science or health hygiene and physiology.

The time allotted to science at the primary stage differs widely from State to State and ranges between 5% to 15% of the total school time. The content of science at this stage covers areas such as animal life, plant life, air, water, weather, human body, health and hygiene, rocks and soils, machines and universe. In classes I and II, though the syllabus prescribes the teaching of science, it receives very little attention. Formal teaching generally starts from class III when prescribed science textbooks are available for study. The emphasis is on textbook reading rather than on learning science through observation, exploration and simple experimentation. The facilities of formal science equipment, nature corners etc. are available in a very few schools.

Science at the middle school stage. Classes V to VII or VI to VIII form the middle stage in a school. These classes are either the top classes of the elementary schools or the lowest classes in a high or higher secondary school. When the middle classes are included in the high or higher secondary schools, the students have the advantage of better-qualified staff available in these institutes than in the middle schools which usually have high-school trained or untrained staff.

General science forms an integral part of the middle stage curriculum in all the States irrespective of the fact whether these classes are in the elementary schools or high or higher secondary schools. The general science syllabus for these classes is usually an expansion of the syllabus prescribed for the primary classes. It is concentric in pattern and deals with the same areas as prescribed for primary schools but at a higher difficulty level, and with some new areas such as energy, matter, and lives of scientists added.

With regard to the allotment of time for the teaching of science at the middle school stage, there is again great variation from State to State. The percentage of total school time devoted to the teaching of science ranges from 6% to about 16%.

The general science syllabus at this stage consists of items of information drawn from physics, chemistry, biology, physiology and hygiene at any stage in their academic career. In most of the states, nationalised textbooks on general science are used at this stage and the textbook continues to be a powerful tool of teaching-learning. There is no regular individual laboratory work as there are generally no separate science laboratories or rooms at the middle school stage. Experiments are done by demonstration. Some States have already started revising their science syllabuses and have new books under preparation.

Science at the higher secondary stage. At the higher secondary or high school stage, different practices are followed in different States and three main patterns of science teaching emerge: (1) in some States, it is taught as compulsory general science for all students; (2) in some States, science is taught as optional disciplines only and no compulsory general science is taught; (3) in some States, the subject is taught to all students as compulsory general science and also as elective science to those who want to offer these as optional subjects.

The time devoted for science teaching varies from State to State ranging from 9% to 14.3% of the total school time. However, in case of elective science courses, offered in the higher secondary pattern (classes IX to XI), the time devoted for science teaching is as much as 60% to 65% of the total school time.

There are general science laboratories in 14,550 secondary schools. Individual laboratories for physics, chemistry and biology are also available in about 7,100, 6,900 and 3,250 secondary schools respectively. About 8,000 secondary schools are without a laboratory.

Demonstration apparatus is usually provided in a high school offering science. Simple equipment for practical work by the students is also available in schools offering optional science courses. In the higher secondary schools, practical work is required of all the students and there are adequate facilities for the same. About 40% of the total time allotted to science teaching is spent in practical work at the higher secondary school stage.

There are about 64,900 teachers teaching science in the secondary sections, out of which about 65% possess a bachelor's degree and 12% a master's degree. The rest possess Intermediate or Higher Secondary certificate. More than 50% of these teachers are trained science teachers. In recent years, the shortage of graduate science teachers has been reduced but shortage of the post-graduate science teachers still continues.

Training of science teachers. About 90% of the primary school teachers possess only a middle or high school qualification. Many of them have not read any science during their schooling. Minimum educational qualification for pedagogic training is generally a high school certificate. The duration of training generally extends for two years, although in some States a one-year programme is also offered. The programme includes general methods and pedagogy; no special attempt is made to train science teachers. The science content forms a very small part of the course. About 25% of primary school teachers in service have received no pedagogic training.

Secondary school science teachers are prepared in one-year post-graduate teacher training colleges where the minimum qualification for entrance is a bachelor's degree. The teacher is generally trained for teaching two school subjects; e.g. science and maths. Many of the training institutions now include a course of content of school science in the training programme. About one-fifth of the total time is spent on the content and methods of teaching science. For the last six years, however, a new pattern of teacher training is being tried out in four Regional Colleges of Education. This is a course of four years' duration where an integrated approach to content and methodology has been adopted.

Curriculum and teaching materials. Up to the middle school stage, the science courses are prescribed by the Directorate of Education of the State government. The work of formulating the curriculum is carried on by the Curriculum Departments of the respective State governments. At the central level, the National Council of Educational Research and Training also prepares model draft curricula which are used as resource materials by the States for developing their own curriculum.

For the high/higher secondary stage, science curricula are prescribed by the Boards of Secondary Education which are autonomous bodies. The Boards work through Committees of Courses where University and school teachers and teacher educators are responsible for developing the science courses. These Boards are also the examining bodies and conduct the public examinations at the close of the secondary stage.

In most of the States, the textbooks are nationalized at the primary and middle school stages. The textbooks are prepared by the State Education Departments with the assistance of private authors or in the department itself through writing teams. At the high school stage, the Secondary Boards recommend a set up of books written by various authors and the schools are free to choose their own books. For the last three years, the National Council of Educational Research and Training has also been preparing model textbooks in science subjects which could be adopted or adapted by the States for their schools. In many of the States, the science curricula have been revised during the last two to three years and some States are currently engaged in revision of their science syllabuses.

Practically all the science equipment required for the schools is indigenously manufactured and is available to the schools from the market. Practically all the Secondary Boards prescribe a list of science equipment which each school is required to have before it can be granted recognition for teaching science subjects. The average norm for the equipment for a middle school teaching general science is about $400 and for the higher secondary schools teaching elective science is about $4,000.

Plans for the future

Considerable expansion in school education facilities took place in the first three Five-year Plan periods. During the Third Plan period, a number of steps were taken by the Government of India and the State Governments to effect qualitative improvement in the teaching of science at the school stage. These attempts were able just to touch a fringe of the problem, however. It is therefore proposed to accord a high priority to the programmes of science education in the Fourth Five-Year

Plan. The following are some of the major objectives which will be emphasized in the future science programmes of the country:

- Science be provided as an integral part of the general education programme at least up to the high school stage.

- To meet the challenge of explosion of knowledge in science, the teaching of this subject be started from the beginning of the school and good foundation of subject disciplines of science may be laid from the middle school stage onwards.

- Science curriculum be upgraded and modernised.

- Necessary physical facilities of laboratories and equipment be made available to as many schools as possible.

- Better pre-service and in-service programme for improving the competences of science teachers to handle the modern curriculum be developed.

- Selected institutions may be encouraged to undertake activity programmes in science through science clubs and science fairs.

Some of the Major National Programmes Currently Going On for the Improvement of Science Education

Curriculum projects

To provide a nucleus of the academic leadership in the field of science education, a Department of Science Education was established in the National Institute of Education in 1963. The major functions of the Department are to undertake research in science education, develop new curricular materials - syllabuses, textbooks, teacher guides, supplementary reading materials, equipment, kits and other audio-visual aids and to undertake leadership training programmes and other pilot training programmes in order to develop training materials for the science teachers. During the last four years, the Department has nearly completed the work of developing text materials, teachers' guides, curriculum guides and selected items of improved equipment for the primary and middle school stages. Work is currently in progress to develop similar materials for the high school stage. The permanent staff members of the Department of Science Education, including content specialists and persons with pedagogic training and experience, in collaboration with experts provided by Unesco, are engaged in the development of these materials. Assistance with materials and expenditure for in-service training programmes is provided by UNICEF.

In 1966, the National Council of Educational Research and Training (NCERT) started a new curriculum project on science and mathematics under which special "Study groups" have been established in 20 Universities and research institutes. These Study groups were primarily established to obtain the expert services of university professors for identifying the basic concepts in the various science disciplines and to present them in a logical way for building of better understanding in the students. Each Study group is headed by a university professor and has a full-time Reader and a few part-time teachers both from the university and the secondary schools. For each subject, there is a Convenors' group with more full-time staff of Readers and Lecturers which coordinates the work of the Study groups. The Study groups have developed new syllabuses and instructional materials. The first-level courses in chemistry and biology comprising of textbooks, teachers' guides and laboratory manuals (experimental editions) have been completed and are to be tried in a few selected schools in different parts of the country before they are finally made available for wider use. Similar materials in physics and mathematics are in various stages of completion. Work has been started on developing similar materials for the Higher Secondary stage in all these subjects.

Preparation of good textbooks in science

As the textbook continues to be a powerful tool of teaching-learning, it was considered necessary to make available good textbooks which may present science concepts and facts correctly and modernize and develop the subject in a logical manner. To achieve this, the NCERT established writing panels of University professors in physics, chemistry, biology and mathematics with the task of developing new textbooks for the higher secondary stage of Indian schools. The panels have developed many materials and a series of biology textbooks prepared by panel are in use in 500 institutions following the Central Board syllabus. Textbooks in physics, chemistry, mathematics and general science are in various stages of printing.

Supplementary reading materials

There has been a tremendous growth in scientific knowledge and its impact on technology and industry. It is not possible to cover all aspects of science within the frame work of a structured curriculum for schools. This necessitates that the children should have access to more science materials which they may be able to read and work with outside the regular classes. There has been a great dearth of such supplementary reading materials in India. Hence, a programme of writing 'Science Readers' has been started. Under this programme, during the last two years, 80 titles have been selected and eminent specialists in the various fields have been invited to write science readers mainly directed towards school students. 7 titles have so far been completed and others are in various stages of development. This programme is also administered and coordinated by the NCERT.

Science talent search

The care of talented students is an urgent need because it is this section of the student population which will ultimately be engaged in creating new science. Recognizing the importance of such talent and nurturing it, a scheme of Science Talent Search was initiated in 1963 as a pilot project and in 1964 the full scheme was started under which 350 students are selected each year at the close of the secondary stage and assisted financially to pursue basic science courses throughout the university stage up to the Doctoral level. These students are also provided an opportunity to come in close contact with leading scientists and research workers through a regular programme of Summer Schools. The scheme provides for a monthly scholarship and book grant, reimbursement of tuition fees and supervision by a guide.

The selection tools comprise a science aptitude test and an essay paper, a project report and finally an interview of selected candidates. At present about one thousand students are receiving the benefits under this scheme. The programme is administered by the NCERT.

Establishment of the Regional Colleges

The preparation of a teacher is a very important part in the total programme of science education. All our science teachers at present receive their content training in a University or college science department and then spend a year learning pedagogy in a training institution. This pattern of training has tended to keep methodology isolated from the content of science. To achieve an integrated programme of content and pedagogy, four Regional Colleges of Education were started in 1963. These colleges train teachers for science, agriculture, technology and commerce through a four-year integrated course of content and pedagogy. Although the number of teachers trained through these four institutions is small compared to the total needs of the country, these institutions are expected to establish the standards to be achieved in training our future science teachers. These colleges are also centres of experimentation and are conducting improved one-year training programmes for science teachers. The colleges also serve as centres for in-service training as well as catalysts in initiating school improvement programmes in associated schools in their areas.

Summer Institutes for Secondary School Teachers

In order to be effective, science teachers have to keep themselves abreast with the latest developments in the fields of science and mathematics which are taking place at a very rapid pace. In-service training of science teachers thus occupies a very important place. The NCERT in co-operation with the University Grants Commission, has been organising each year a number of Summer Institutes in physics, chemistry, biology and mathematics for secondary school teachers. These institutes are organised in various universities under the direction of University professors. The participants in the institutes are exposed to new curricular materials in the field of their teaching subject. The special emphasis is laid on the new techniques of teaching and learning of science. The teaching materials at present being used are those which have been developed in other countries. It is proposed that the new curricular materials developed in India under various curriculum programmes mentioned earlier will be used in future summer institutes. (61 institutes were organized in 1968, and 2, 302 teachers of physics, chemistry, biology and mathematics received training under this scheme).

Correspondence Courses

As many of the science teachers at present working in the Secondary schools are untrained science graduates, a correspondence programme has been started for the last two years in the four Regional Colleges of Education and the Central Institute of Education at Delhi. On-the-job, 'untrained teachers' receive a course of lectures through correspondence and have to spend eight weeks during the summer vacations at the Institute to undergo practical training. After this course, they are eligible to take up the B.Ed examination at various Universities to qualify as trained science teachers.

Strengthening science teaching at the secondary stage

In 1964-65, the Ministry of Education started a 'crash programme' of improving the position of science teaching, especially of elective science teaching, at the senior secondary stage. There are three major components of this programme:

1. To provide funds for the purchase of science equipment for secondary schools established up to the end of the Second Five-year Plan period. During the last three years, under this scheme financial assistance to the tune of Rs.51.5 million was made available to the State governments for the purchase of science equipment in the secondary schools.

2. To develop an academic and technical organisation at the State level to constantly review, improve and guide the school science programmes of the States. Under this scheme, 13 States have so far established State Institutes of Science Education which serve as a technical arm of the Education Directorate of the State governments and as in-service training centres for science teachers. These institutes undertook a number of other programmes in the field of science education depending on the local needs and problems in the State. The institutes also serve as the main collaborating agency for the Department of Science Education of the NCERT and disseminate the materials developed at the national level for use at the State level after necessary adoption, adaption and translation.

3. To organise long-term and short-term training programmes for science teachers. Under these programmes, a nine-month content course at the post-graduate level is organised with the assistance of university faculties or in the State Institutes of Science Education to train science teachers for the elective science courses at the higher secondary stage. The institutes also conduct short-term in-service courses of from four to ten weeks.

THE SCIENCE TEACHING PROGRAMME AT THE FIRST AND SECOND LEVELS IN INDONESIA

General Information and Data

Within the Ministry of Education there are five Directorates General; one of them is the Directorate General of Basic Education. This has five Directorates together with the Institute of Educational Research and Development which has four Research Centres:

1. Science and Mathematics Teaching Research Centre;
2. Teaching Aids Research Centre;
3. Curriculum, Methodology and Instruction Research Centre;
4. School Building Research Centre.

The overall objective of education is to build up well-trained manpower and to supply responsible citizens for the needs of developing the country and increasing the prosperity of the nation.

The curriculum is formulated by the Inspectorates of the appropriate school level in co-operation with the Institute of Educational Research and Development and other institutions. The Minister of Education and Culture proposes to set up a Curriculum Board, to be attached to the Ministry.

First level of education

Curriculum and Course Content

According to the Indonesian Law of Education, children of 6 years of age are entitled to enter the first grade, and those who are 8 years of age have to be accepted in the elementary school (grades I-VI). About 2.5 per cent of the children who enter the first grade have attended Kindergarten.

This article is a condensation of a paper prepared by Mr. Jahja Ranawidjaja, Chief, Section of Science Teaching, Institute of Educational Research and Development, Indonesia.

Elementary science is taught in the form of nature study in the first three years. As offered now it draws from both the biological and physical sciences. From the fourth to the sixth grades, science is taught as separate disciplines: biology and physics.

Although each child should be allowed to progress at his own rate, because of over-emphasis on the examination the present science syllabus is too rigid. It is hoped that a more flexible syllabus where schools can choose certain areas in the syllabus relevant to their environment will be designed.

Time allotment for science subjects, in periods per week:

Grade	I	II	III	IV	V	VI
Elementary science	2	2	4	4	4	4
Arithmetic	7	7	7	6	6	6
Total school time	28	28	40	40	40	40

(For grades I-II, one period is 30 minutes, for III-VI, 40 minutes)

Teaching personnel

All teachers in elementary schools teach science along with other subjects. Many elementary school teachers in rural areas begin teaching only 4 years after their elementary education; only in urban areas do they have a Teacher Training School Certificate (6 years after the elementary school). Only a few teachers have received training in modern science education. There are some upgrading courses for elementary school teachers organized by the Directorate of Teacher Training.

Even though the number of elementary school teachers is large (290,000 in 1967), it is still not sufficient for a country as vast as Indonesia. The required teaching load is about 27 clock-hours per week, and many teachers have to double their teaching assignments.

Teaching techniques and evaluation

Most teaching follows a subject-centred approach, consisting of much telling or reading aloud on the part of the teacher, with few demonstrations and no laboratory exercises.

Classroom teachers make their own periodic tests, usually the conventional types of recall test. At least five tests are given for each quarter. An elementary school diploma is awarded upon completion of the State's final examination.

Teaching materials

Present textbooks are inadequate and relatively expensive; pupils have to buy their own textbooks. Where textbooks are not used, teachers are given notes on the covered topics. Teacher's guides are available, but library facilities are almost non-existent.

In elementary schools very few science teaching materials are available. In some there is home-made equipment but in many of them there is none at all. Parents' Associations sometimes help the schools in providing teaching materials, and prototypes of simple apparatus are now being developed by two Research Centres.

Inspection/supervision

Inspection/supervision in each province is coordinated by an inspector and in each district by a head-supervisor. Each of the 20 supervisors has about 30 schools to look after. Inspectors and supervisors are generally not specialists in any subject fields. In-service training in modern science education for supervisors is now being given, however, by the Science and Maths Teaching Research Centre. Upon their return they start local courses for their colleagues and subordinates. In-service courses for headmasters and teachers have been held by the Provincial Science Teaching Centres since 1960. The results are very encouraging, but the Centres need more funds.

New developments

An elementary general science curriculum has been recommended by the Science and Maths Teaching Research Centre. A general science programme is far more flexible than are separate courses in biology and physics, and can be more easily adapted when compulsory education becomes more common. The general science curriculum includes:

Grades I-III: study of environment. This study is meant to be helpful to the child in forming a basis for further studies in both the natural and the social sciences.

Grades IV-VI: elementary science. This is an extension and deepening of the natural science experiences gained during the study of environment course. It provides the pupils with a basic knowledge of science, enough to satisfy the needs of those who leave school after grade VI, and to provide a background for those pupils who will continue.

Second level of education

Students possessing an elementary school certificate should be able to enter the junior secondary schools but there are not yet enough schools. Every student of the general junior secondary school (grades VII-IX) has to take from four to five 45-minute periods of general science per week. Formerly, science was taught as separate disciplines: biology, physics, and a little chemistry.[1]

Students of general senior secondary schools study science as shown in the time-allotment table.

Time allotment, showing number of periods per week:

Grade	Arts			Science	
	X	XI	XII	XI	XII
Physics	4	-	-	4	4
Mechanics	-	-	-	2	2
Chemistry	4	-	-	4	5
Biology	3	-	-	3	3
General science	-	2	2	-	-
Total (science)	11	2	2	13	14
Mathematics	5	2	2	6	7
Total school time	42	42	42	42	42

(One period is 45 minutes)

Syllabi for physics, mechanics, chemistry and biology were last revised in 1960. General science was introduced in 1960 for arts and social science students. It has the character of applied science.

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[1] This change is not reflected in the subject time-allotment table in the last issue of the Bulletin (p. 56). The data in the table for senior secondary science subjects also represent a change from that previously shown.

Teaching personnel

About 60 per cent of the science teachers of general junior secondary schools have only a Teacher Training certificate for elementary schools. These are not specifically trained for science teaching. About 35 per cent have passed a subsequent one-year teacher training course for science teachers. About five per cent have a Bachelor's degree majoring in science.

Most science teachers of general senior secondary schools have their Bachelor's degree, majoring in physics, chemistry or biology, but many are not adequately trained to teach science.

While, for both junior and senior secondary schools the required teaching load is 13.5 clock hours per week, the average actual teaching load is 35 clock hours per week.

Teaching techniques and evaluation

Many teachers are using the traditional method of teaching because of the importance placed on examination results, although some trained teachers try the discovery method. Experiments and demonstrations are sometimes carried out with simple apparatus.

At least two tests are given for each quarter. All the tests are prepared by science teachers themselves, but most teachers lack the skill to evaluate their students effectively. They tend to test only factual information; home-work and extra-curricular activities are not evaluated. A general junior secondary school diploma is awarded after passing the State's final examination.

Only in cities with universities are new methods in science teaching tried in the senior secondary schools. There, tests are again prepared by the teachers, but are often not geared to the objectives of the course. A paper on science is a pre-requisite for the State's final examination. One of the science subjects, physics, chemistry or biology is examined nationally. Students entering a university must take an entrance examination.

Teaching materials

As in elementary schools, there are few library facilities, textbooks and instructional materials are far from sufficient, and most are old-fashioned. Teacher's guides in the Indonesian language are not available.

A few senior secondary schools have the use of central laboratory facilities in Djakarta, Medan, Joghakarta and Surabaja, one central laboratory being used by about 15 schools.

Prototypes of simple science apparatus are developed by the Science and Maths Teaching Research Centre and Teacher Training Colleges. A home-made science kit for chemistry is now available, but schools have no budget to buy it. Some schools have such a kit donated by the Parents' Association.

Inspection/supervision

Each province has an inspectorate, but there is no inspector specifically for science. There are, however, training facilities in science teaching for inspectors/supervisors at the Science and Maths Teaching Research Centre, Bandung.

New developments

Recommendations for a new general science curriculum for grades XI and XII have been made by the Science and Maths Teaching Research Centre, Bandung. The new curriculum will be tested at a pilot school in Bandung next year.

Preliminary studies of the existing curriculum for physics, mechanics, chemistry and biology are now being undertaken by the Science and Maths Teaching Research Centre, Bandung.

A large Study Group for Chemical Education was set up in Bandung in February 1968. Objects of the study are curriculum reform studies and evaluation of experiments. The Institute of Educational Research and Development is making preparations to set up Study Groups for Physics and Biology Education.

Major problems

In general, the science curriculum at each school level is rigid because of its examination-centred character. Schools should be free to expand the subject matter into courses of study appropriate to their environment.

The Science teaching has been traditional, examination oriented, and dependent upon rote learning of facts. The discovery approach, and development of the scientific process should be cultivated in students.

There is a shortage of school buildings and classrooms. Many schools function with two sessions, some with three. Class enrolment is generally large and hence activity work within the classroom is difficult.

There is a lack of instructional materials and laboratory equipment. Microscopes, projectors, films, filmstrips and slides need to be provided. Modern textbooks and teacher's guides are needed, and library facilities are urgently required.

There is a lack of qualified teachers, teacher educators, and science supervisors. The budget should be increased to provide schools with the necessary facilities and to expand the in-service programme for teachers. Teachers are overloaded with teaching assignments, often carrying double assignments. They have no time to think about modern trends in science teaching or even to adequately prepare traditional lessons. Low salaries cause some of them to abandon teaching. Improvement of the teacher's salary and status and better conditions for work are necessary.

Future developments

Five Provincial Science Teaching Centres have already been established and it is proposed to establish five more. These centres will be equipped with science apparatus under the Colombo Plan. The centres are conducting research into new techniques and designs for experiments, demonstration apparatus and new science teaching methods. They will also expand the in-service programme for teachers and organize workshops for instructional development, including programmed learning techniques.

It is hoped that fellowships for training key personnel on new concepts and techniques in science teaching will become available. A summer course institute for teachers could then be set up.

THE SCIENCE TEACHING PROGRAMME IN THE REPUBLIC OF KOREA

Educational background

The education system in Korea is organized on a 6-3-3-4 basis: i.e., six years in primary school, three years in middle school, three years in high school and four years in college. The six years of primary school are compulsory.

Enrolment at all levels has soared from about 1,472,000 in 1945 to nearly 7,000,000 in 1967, or substantially more than four-fold. The rapid expansion of enrolment has been accompanied by a comparable increase in the numbers of schools and teachers.

The budget for education has also been increased and has gained in importance in the general budget of the Government, compared with the year 1948 when the Government was established. There have been some difficulties in meeting the needs of education qualititatively, however, because the quantitative expansion has outnumbered the Government's fiscal growth capacity.

The present status of science education

Curriculum

In Korea, curricula are made by the Ministry of Education. The present science curricula of primary and secondary schools were made in 1963 by a council consisting of 30 representatives of the respective fields of science at all levels of education.

This article is based on a paper prepared by Dr. Chung Yun Tai, Professor, Seoul National University, and Chairman, Science Education Study Committee, Seoul.

The objectives of science education may be divided into three categories: understanding and knowledge, ability and skill, and attitude.

The objectives of primary school science teaching, in abbreviated form, are the following: (1) to foster an understanding of animate and inanimate things and the rules governing them ... to lead to effective living by understanding that scientific phenomena are deeply related to everyday living; (2) to develop students' ability to handle tools, equipment, and chemicals and to teach them the feeding of animals and plants; (3) to develop the abilities of finding problems, of gathering, analyzing, and organizing the information and of drawing conclusions; (4) to foster an understanding of nature through stimulation of students' interest and to develop the attitude of conserving natural resources and respecting scientific achievement. Objectives of middle school science teaching are similar to those of primary science, but entail deeper penetration (nature study gives way to general science).

The objectives of high school science teaching can be summarized as: (1) to develop better understanding of basic principles, concepts and facts of nature; (2) to develop the ability to solve problems through observation and experimentation, gathering and analyzing data and applying the knowledge to new problems; (3) to foster in pupils an enquiring mind; (4) to teach the structure of science and an understanding of its contribution to civilization; (5) to teach the application of scientific knowledge to daily problems, toward effective living and improvement of socio-economic growth.

Because each level of school education is final for some pupils, the science course at each level attempts to be comprehensive with the greatest difference being in depth. The science curriculum in primary education consists of nature study of from 2 to $2\frac{1}{2}$ periods per week in grade I to an average of 4 periods per week in grades V to VI. The middle school curriculum is generally 3 to 4 periods per week of general science. At the high school level (grades X-XII), 6 periods per week of biology are compulsory for all during each of the three years. In addition, students in the Arts Streams may elect to study up to 6 periods weekly in earth science. In the Science Stream, students will elect to study from physics and chemistry (12 periods per week), biology (6 periods per week), and earth science (4 periods). 1/

Texts and teaching materials

The science textbooks for primary school nature study are prepared and published by the Ministry of Education. The current textbooks were published during 1964-1966; some parts have been revised every year.

The textbooks for secondary schools are published by the authors with approval of the Ministry. The current middle school textbooks have been used since 1966, and the present textbooks for high school only since 1968. The number of pages in these approved textbooks is limited by regulation of the Ministry, owing to the lack of financial resources. Accordingly, these books need to be supplemented by oral explanation. Because of financial stringency, students have neither classroom readers nor laboratory guides, and the school libraries lack science teaching references.

Science teachers and laboratory facilities

Primary school teachers are graduates of junior colleges for teachers. Through the school years, courses in science have been offered with only six units alloted to four fields: physics, chemistry, biology and earth science. This is not sufficient for the preparation of primary teachers.

Science teachers of secondary schools are graduates of four-year colleges of education or two-year graduate schools of education. The minimum requirement for graduation from the colleges is 160 credits, of which 40 credits are in general education, 30 credits are in professional subjects and nearly 90 credits are in major subjects of science. Other college graduates with science majors are licensed to teach science if they subsequently take the professional subjects.

According to the results of a survey made by the Central Education Research Institute, the teachers teach on average 19

1/ For more complete data on curricula, refer to the previous issue of the Bulletin, pages 61-63. Earth science appears as geology.

hours a week, and some teach as many as 24 hours a week. With too much administrative work, available time for preparing classroom experiments is insufficient. The high pupil-teacher ratio constitutes an additional difficulty.

Facilities for effective science teaching are inadequate. Throughout the nation, 36.1 per cent of high schools and 79.1 per cent of middle schools do not have laboratories. Moreover, 33.3 per cent of the laboratories in middle schools and 61.1 per cent in high schools have no water supply, and many lack electricity. Finally, the supervising activities for science teachers are very ineffective as far as providing them with professional advice is concerned.

Science teaching programmes in progress

Science Education Study Committee

According to the Science Education Promotion Law made in March 1967, and the regulations made in April 1968, a Council for Science Education acts as the advisory committee for the Ministry in formulating policy on science education. Previously, science education policy had been set and implemented chiefly by officials who were not specialists in science education. With the Science Education Study Committee in operation, specialists in science will present their views on the formulation and implementation of the policy on science education. Furthermore, when the Science Education Fund is established it will do much to stimulate research and the production of teaching aids.

The Science Education Study Committee (SESC) consists of specialists in science education, scientists and school teachers. As authorized in 1967, under the SESC, there are six sub-committees in the following areas: physics, chemistry, biology, earth science, mathematics and primary school science.

The SESC has assisted in the introduction of new science curricula in the physical, biological, and earth sciences, and in chemistry. It has established science teachers' retraining institutes where a number of new science curricula are taught. These curriculum projects, being developed in the United States of America, are listed at the end of this article.

Science Education Renovation programme

At a "Seminar for New Science Education" in 1968, the participants arrived at the following conclusion, which the Ministry followed in making the Science Education Renovation Programme:

"Science is a continual process of human efforts to understand the physical world and the co-relationship between events in the universe. At the same time, it is a motivating force for industry and technology which are closely related to human life and welfare.

"According to the new definition of science, science education should be improved in accordance with modern science teaching methods. Traditional science teaching which almost completely depended on the explanation of terminology and the remembering of fragmental knowledge must be abandoned. Science should be taught to make scientifically-oriented people and to let them challenge the world of nature. This revolution in the field of science education is the most urgent national mission".

Study and pilot courses

Requested by the Ministry, a Science Curriculum Workshop was held in 1966, in order to make an outline for the pattern of secondary school science. The report was submitted to the related agencies.

Studies on new science curricula in the various areas of science teaching have been carried out and the results presented at seminars. Pilot courses in these curricula have been held at 31 schools since 1966.

2,050 kits, "Exploring Science", donated by the Asia Foundation, have been distributed to nearly 1,000 schools throughout the nation. In order to train primary school teachers for the utilization of the kit, special programmes at 14 junior colleges for teachers were offered in 1967/68.

The Chemistry Education Study Committee, a Korean organization co-operating with the Unesco Pilot Project for Chemistry Teaching in Asia, held seminars under the co-sponsorship of the Unesco National Commission of Korea, and the Korean Chemistry Society in 1966/67 and 1968.

CHEM Study films were used more than 100 times in one year by colleges and institutes, and new materials for experiments and books were distributed to colleges of education and secondary schools. The Science Education Study Committee publishes news letters in order to inform teachers and administrators of new curriculum ideas.

Unesco/UNICEF assisted project

This project, beginning with the mission of a Unesco expert in 1966, has been largely responsible for the organization of teacher retraining courses through institutes and seminars in their present form. The project proposal, slightly revised by the Ministry, includes the following components: (a) the retraining of science and mathematics teachers for using the new curricula at the three national colleges of education, (b) expansion of facilities at the colleges of education, and the training of the students in the new curricula, (c) financial support for the publication of new textbooks, teachers' guides and other related materials (the publication of physics, chemistry and IPS middle school physical science texts has been completed and translation of other texts and teachers' guides is underway), (d) organization of an experimental project for primary school science education, (e) preparation of a status survey to give data needed for policy making.

Future programmes for science education

The movement toward a new outlook in science education is well underway in the Republic of Korea. According to the decision of the Ministry to accept the new curricula and to adapt them to the nation's circumstances, the existing science curriculum will have been revised by the end of 1969. In the high schools, the new courses in physics, chemistry and biology will be being taught by 1971. In middle schools, new curricula in earth science and physical science will be in operation by 1974, and from 1975 the ESS primary school science programme is to be taught.

References

The U.S.A. curriculum development projects referred to in this article are as follows:

BSCS	Biological Sciences Curriculum Study University of Colorado, P.O. Box 930, Boulder, Colorado 80302.
CHEM Study	Chemical Education Material Study
SCIS	Science Curriculum Improvement Study Lawrence Hall of Science, University of California, Berkeley, California 94720.
ESCP	Earth Science Curriculum Project P.O. Box 1559, Boulder, Colorado 80302.
ESS	Elementary Science Study
IPS	Introductory Physical Science
PSSC	Physical Science Study Committee Physics Education Development Centre, 55 Chapel Street, Newton, Massachusetts 02160.
SMSG	School Mathematics Study Group Cedar Hall, Stanford University, Stanford, California 94305.

SCIENCE EDUCATION IN WEST MALAYSIA

General Background

Education in Malaysia is centrally administered by the Ministry of Education. Both Government-assisted schools and independent (private) schools are subject to the supervision and regulations of the Ministry. All the schools in the country adopt common-content syllabuses with a Malaysian-oriented outlook and a uniform curriculum prescribed by the Government which, through its educational policy, seeks to integrate the cultures of the people using, eventually, the National Language, Malay, as the main medium of instruction.

The school system is divided into the Primary School (Standards 1 - 6), the Lower Secondary School (Forms 1 - 3), the Upper Secondary School (Forms 4 - 5) and the Post-secondary School (Form Lower and Upper Six).

Promotion throughout primary education is automatic. All children having completed six years of primary education are automatically promoted to the lower secondary course which provides non-selective education for three years after the primary school age, ensuring that no child is judged too early in preparation for suitable employment.

At the end of 3 years (if change of language medium, 4 years) all pupils must sit for a national public examination. The pupils who find places in the upper secondary classes are divided into groups or streams, on the basis of performance at the examination. After 2 years of Upper Secondary education, there is another examination which serves as the basis for admission to the post-secondary Sixth Form Classes.

Science teaching in primary schools

The aim of science teaching as a whole is to provide a firm foundation in science subjects for all, with an adequate proportion of manpower specialising in the various fields of science.

This article is a condensation of a paper by Mr. Chang Kwai, Senior Organiser of Science, Ministry of Education, Malaysia.

Science at the first level is compulsory and is taught as nature study. The school courses of study provide a minimum of 90 minutes (Standards 1 - 4) and 120 minutes (Standards 5 - 6) for this subject, but the implementation of this depends largely on the availability of teachers who are able to teach science.

Owing to historical circumstances, the urban schools are better-equipped than most of the rural schools but steps are being taken to equalize the facilities for the science curriculum.

Science teaching in the secondary schools

Secondary schools are divided into lower secondary and upper secondary. At both these levels, science is a compulsory subject. In the lower secondary school, however, science is presented as general science, the content areas in physics, chemistry and biology being more or less equal. Owing to a rapid expansion, some of the science classes are taught in the classrooms, which is against the recommendation requiring science to be taught in the laboratory during every lesson. It is hoped, however, that at the end of the First Malaysian Plan (1966-1970) most of the lower secondary schools in Malaysia will be equipped with facilities for the teaching of science.

The upper secondary school is made up of the general academic stream and the vocational stream. In the academic stream, pupils must study at least general science which is a core-subject in the curriculum. General science occupies at least five periods (of 40 minutes each) per week out of a 40-period week. Some pupils also study "additional general science", spending another 4 periods a week on it. Usually the more science-inclined pupils study physics, chemistry and biology as separate subjects. In this case a total of 15 periods is devoted to the three subjects. All the science syllabuses at this level are those of the Cambridge Overseas School Certificate. "Physics-with-chemistry" as a subject is being replaced by the new "Physical science".

Teaching personnel

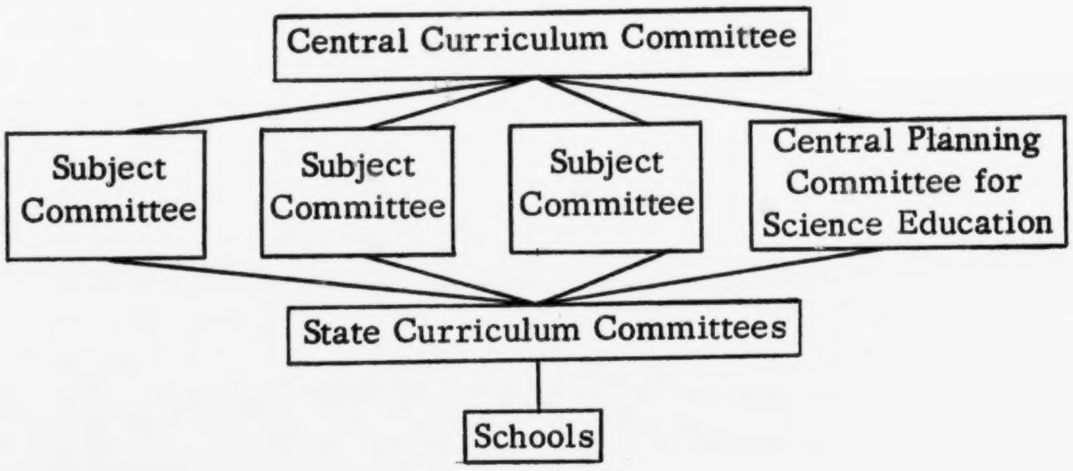
Primary science teachers are expected to include science as one of the many subjects that they are required to teach. Primary teacher trainees are now required to study science content and method, and the majority of trainees have studied science during their school days.

In lower secondary schools, teachers at this level are mainly college-trained and the majority of them are graduates of two-year courses at the Malayan Teachers College (M.T.C.) in Penang. Trainees receive 6 hours of instruction per week on "science content" and 1 hour per week on "teaching methods" with a corresponding time allotment for the mathematics subjects.

Science subjects in the upper secondary school and at post-secondary level are normally taught by graduate teachers with at least a basic science degree. After obtaining a basic science degree, graduate teachers are professionally trained at the Faculty of Education, University of Malaya, Kuala Lumpur. They undergo a one-year Diploma of Education full-time course with about 10 weeks of teaching practice during the year. To relieve the acute shortage, science teachers from overseas, including many volunteers through various programmes, are now being recruited.

Curriculum and teaching materials

A Central Curriculum Committee was established some three years ago. A Central Planning Committee, directly responsible to it was recently formed with an overall responsibility in the planning and implementation of science programmes in schools, as shown below.


Central Curriculum Committee
Subject Committee
Subject Committee
Subject Committee
Central Planning Committee for Science Education
State Curriculum Committees
Schools

Textbooks

Textbooks have been written by free-lance authors who are usually experienced local teachers. There has been a steady increase in the number of local authors writing science texts for the primary and lower secondary schools. However, owing to the nature of science syllabuses in the upper secondary and post-secondary schools, foreign books are largely used. Upper secondary syllabuses have been very closely related to those of various Examination Boards in the United Kingdom. In view of the current innovation in science programmes in the lower secondary school, however, and the expected abolition of the School Certificate Examination in 1970, local authors will assume a greater responsibility in writing textbooks for the upper secondary school.

The science syllabus for the primary school was revised in 1965. The purpose of revision was to give a more balanced time-allotment in the subject areas of biology, physics, chemistry and earth science.

Equipment and laboratories

The cost of equipping a lower secondary school laboratory with basic apparatus is about U.S. $5,000 (M$15,000). An additional $3,000 is required to make the laboratory suitable for upper secondary school science teaching. In view of the changes evolving in the approach and method of teaching science, however, the Ministry is now studying a new design for science laboratories. Beyond laboratory cost, the government spends over one million dollars annually as recurrent science grants for equipment and chemicals.

The number of schools, especially in the rural areas, has increased so rapidly that some secondary schools are still without any science laboratory, but it is hoped that by the end of the First Malaysia Plan (1966-1970) most secondary schools will be fully equipped with laboratory facilities for science teaching.

Science equipment and apparatus have been imported, but simpler indigenously manufactured items are finding a demand, owing to their relatively low cost. Elementary science in the primary school is taught in the classroom and most of the apparatus used is improvised by the teacher.

Inspection/supervision

At the national level, there are about six school inspectors. Each State has a State science supervisor who is normally a senior science teacher in the State attached to a premier school. These Supervisors are taking on an increasing load of responsibilities as new science programmes are being tried out in schools.

The Federal Inspectorate is advisory in nature and is directly responsible to the Minister of Education. Science inspectors are recruited from Senior science teachers.

New programmes

The integrated science programme in the lower secondary school

To encourage understanding of scientific concepts through the investigatory/enquiry approach, the Ministry is now trying out an integrated science programme for lower secondary school, based on the Scottish Integrated Science programme. The British government is assisting the programme through its co-ordinating unit: the Centre for Curriculum Renewal and Educational Development Overseas (CREDO). The course is almost entirely experiment-oriented and pupil-centred. The subject areas of physics, chemistry and biology are logically integrated and developed. The topics covered are the following:

1. Introducing Science
2. Looking at Living Things
3. Energy - The Basic Idea
4. Matter as Particles
5. Solvents and Solutions
6. Cells and Reproduction
7. Electricity
8. Some Common Gases
9. Making Heat Flow
10. Hydrogen Acids and Alkalis
11. Detecting the Environment
12. The Earth
13. Support and Movement
14. Transport Systems
15. Electricity and Magnetism

Beginning with a group of 21 pilot schools, the syllabus will be revised for trial in another 50 schools in 1970. A twice-revised syllabus will then be tried out by about 100 schools, and it is hoped that in 1972, all schools (Form I) in West Malaysia will be using the final version. The upper secondary school science syllabus may subsequently be revised.

During the trials, four Scottish science educators will continue to conduct in-service courses for teachers, and laboratory attendants will also be trained at in-service courses to make and store apparatus for the new programme.

Meanwhile, some 100 graduated teachers have taken a "familiarization" course on Nuffield Science, so that they may teach new science programmes more effectively.

The proposed national science centre

The Ministry has started planning the establishment of a National Science Centre to serve as a "nerve-centre" for co-ordination of various evolving processes in science education. The main functions of the various units will be as follows:

Biological Unit: To prepare microscope slides and biological specimens of local flora and fauna for both examination and instructional purposes, and to help enhance the study of ecology.

Bulk Purchase and Distribution Unit: To purchase equipment and chemicals in bulk at fair prices and distribute them to schools.

Design Testing and Manufacture Unit: To design, test and manufacture, on a small scale, suitable prototype apparatus for school use. To recommend the most suitable and economical items.

In-service, Extra-Curricula and Documentation Unit: To look into in-service training (in conjunction with the Teacher Training Colleges) of teachers and laboratory technicians, and to diffuse information on science education.

The establishment of the National Science Centre will, it is hoped, impart an impetus to the efforts in improving science education generally. Capital and recurrent expenditure will be needed, but substantial savings are expected to be made in the costs of providing equipment and materials to schools.

The proposed special project on primary science and mathematics

Elementary science teaching in the national primary school is not as up-to-date as it might be, as the majority of the teachers have no science 'background' at all. A plan has now been made to supply instruction/guide sheets to the teachers, spelling out definite plans of approach, methods of teaching and the type of aids to use. Modified programmed worksheets will be supplied to the pupils. The instruction/guide sheets will be written by four full-time educators. In the process, revision of the primary science syllabus is also envisaged to bring the course in line with the new science programme in the lower secondary school.

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SCIENCE TEACHING PROGRAMMES IN NEPAL

General Background

Due to the geographical position of Nepal, its educational system has born similarity, both in form and content, with Indian educational systems. It has been influenced by successive waves of impact from India - the Aryan, Hindu, Buddhist, Moghul and finally the British system of education gradually superimposed one upon another, and Nepal has accordingly a colourful, varied and dynamic educational background. The present system is briefly summarised in the following paragraphs.

Pre-primary stage (Ages 4-6, Grades Ia-b)

There are at present a limited number of pre-primary schools, some of them running on an experimental basis. Children are given an education on the Montessori model. Some of these schools are gaining popularity. Many children get their pre-primary education in their homes (and some even their primary education) where their parents and elders teach them reading, writing and arithmetic. Every year around February, at the festival known as Saraswati Pooja - worship of the Goddess of Knowledge - children just about to begin their alphabets are led to a temple of the goddess by their elders and helped to inscribe some letters on the walls of the temple or nearabouts. From that day onwards they start reading in their homes.

Primary stage (Ages 6-10, Grades I-V)

At present there are about 6,000 primary schools, and roughly 40,000 children are enrolled. Vigorous steps are being taken by the government to make primary education free and compulsory for all. The present curriculum includes such areas as language (English, Nepali), health, science, mathematics, arts and music. Due to increasing demands for primary education, several secondary schools have opened primary wings within the last eight years. Formerly most of the schools were of the middle or the secondary type.

This article is a condensation of a paper by Mr. Ganesh Bahadur Mali, College of Education, Kathmandu, Nepal.

Science became a part of the primary school curriculum in about 1960. The broad divisions in science, according to the present syllabus, are as follows:

Grade I - Living things - weather - the sun.

Grade II - Living things - weather (continued) - plants.

Grade III - Plants and animals - earth's surface - machines - light - sound - the moon.

Grade IV - Living things and their needs - the solar family - machines - light - matter.

Grade V - Living things - air - constitution of matter.

Middle and secondary stages (Ages 10-15, Grades VI-X)

The number of secondary schools went up from 21 in 1950 to 741 in 1966. School enrolment is also increasing at a rapid rate (41, 279 in 1961 to 69, 100 in 1966) so that most of the school rooms are overcrowded. The government is encouraging local educators to open up more schools.

General science is compulsory from grade VI to grade X. The middle and the high school curriculum cover almost all branches of science: physics, chemistry, biology, geology, human physiology and astronomy. Progress is being made in reorganizing the curriculum along modern lines.

In grades IX and X, students can take optional courses in physics and chemistry or biology out of several other fields (home science, arts and crafts, mathematics, etc.) Those who take up optional science courses have a better chance of being enrolled in science colleges.

After completing grade X, the students have to sit for the School Leaving Certificate (SLC) examination conducted under the supervision of the SLC board of studies (established in 1950). After SLC a student is eligible for admission into colleges or other post-school studies.

College stage (Age 15-19, I-IV yrs.)

At present there are two sub-stages of two years each - the Intermediate and the Bachelor's. There are science, arts, commerce and law colleges. Law, however, can be joined only after graduation. There are also five normal schools and a College of Education for the training of teachers. In the Intermediate stage, English, Nepali and three other subjects are offered. In the Bachelor stage, English and Nepali are dropped and three major areas out of the remaining three subjects are taken up. Thus in science, during the Intermediate stage the three subjects may be selected from physics, chemistry, biology and mathematics, and in the Bachelor stage the three areas may be selected out of physics, chemistry, zoology and botany, and mathematics. The Intermediate and the Bachelor degrees are given by the Tribhuban University.

Science in the Schools

General science was introduced as a school subject around the year 1943. But although the beginning was late, the development is comparatively rapid, especially within the last seven years (1961-68).

Science at the first level

The objectives are: (a) to enable children to get functional knowledge of nature by being actively involved; (b) to develop scientific attitudes; (c) to develop the faculty of critical thinking.

The curriculum now in use was prepared by a committee of experts under the Department of Primary Education. Nature study covers the major portion of the curriculum.

Science is now compulsory at the primary stage. Textbooks based on the new curriculum are prepared by the Educational Materials Production Centre, but efforts from local writers are also welcomed. A textbook committee selects the best among the texts presented. From three to six hours per week are devoted to the teaching of science at the primary level. Chalk and duster are as yet the only teaching aids used in most of the schools, partly due to the lack of educational facilities and partly due to the lack of trained teachers.

Science at the second level

The main objectives are: (a) to gain functional knowledge of nature;(b) to develop the faculty of critical thinking and logical reasoning; (c) to develop scientific attitudes.

A new curriculum framed by a committee of experts under the Department of Secondary Education is now in use. Textbooks written by the Educational Materials Production Centre and also by local authorities are in circulation. Except for a few multipurpose schools, and some schools in urban areas, most of the rural and urban schools are still running without adequate facilities. According to government regulations, 3-6 hours per week should be devoted to the teaching of science. In most schools, however, only three hours of science are prescribed. As already mentioned, in grades IX to X, students can take optional science subjects. About 10% of the secondary students opt for science subjects. The teaching of science is carried out through the lecture and demonstration method; the laboratory method is seldom used.

Teaching personnel

The College of Education in 1960 opened up science programmes for those who choose to make science teaching their profession. Four years of training are required for the SLC passed candidates, two years for intermediates and one year for graduates. Degrees given are intermediate and bachelor in education. Intermediate passed trainees are qualified to teach up to the middle school stage, and bachelors in education can teach science up to the high school level. However, only five or six students take up science courses every year. This number is not enough in view of the increasing demand for trained science teachers. It is hoped that more will be admitted in subsequent years.

The normal schools take up the responsibility of producing teachers for the primary schools.

Until 1961, those who had passed the Intermediate examination in science were eligible to be science teachers at all levels of school teaching. Due to the lack of not only science graduates but intermediate graduates as well, however, arts teachers or just SLC-passed teachers have to teach science in most schools. This means that teacher training institutes should take increasing responsibility for providing trained teachers to the increasing number of schools, and also for training those who are in service as science teachers but who have inadequate science background.

The efforts taken up, in this respect, in collaboration with other agencies are:

1. The opening up of science courses in the College of Education for prospective science teachers. They must also take courses in methods of teaching science. Such courses started in 1960-61.

2. The organization of in-service training workshops in general science at the primary as well as secondary level.

3. The opening up of activities in the normal schools to produce more science teachers at the primary level.

4. The preparation of textbooks and day-to-day lesson manuals based on modern lines by a group of U.S. Peace Corps volunteers. This is known as the Science Teaching Enrichment Programme (STEP).

5. The provision of advisors and materials to the College of Education and other schools in order to facilitate science education in the country (Unesco/UNICEF).

6. The training of science teachers in advanced science for the multipurpose high schools (these schools offer a diversified range of courses including vocational subjects).

In spite of these activities, the progress made is far from being adequate to meet the country's needs. Up to now, about 150 science teachers have been trained along modern lines, but in a country with a rapidly expanding network of schools, this number is quite insufficient. To place one trained science teacher in each school would require at least 7,000 trained science teachers, and the present number does not meet even 5% of this requirement.

Teaching materials

The usual procedure of framing curricula is not yet based on research and elaborate studies. A committee of experts, set up by the Department of Education, proposes a curriculum which when passed by the final authorities is circulated throughout the schools for implementation. Usually after a period of 3-5 years the curriculum is revised to incorporate any new advancements. A textbook committee examines and selects texts prepared by the Educational Materials Production Centre or other interested authors.

Most teaching aids, such as scientific materials and equipment are imported from India. There has been some attempt to produce such aids locally but so far without much success. Material aid given by some foreign agencies in recent years has helped science education, and the Science Equipment Centre recently established near Kathmandu with assistance from Unesco and UNICEF is a noteworthy contribution in this respect. Production centres for equipment and materials in the country itself, however, are yet to be established. Such establishments, although costly in the beginning, should in the long run greatly facilitate the teaching of science.

Most of the schools in Nepal were established before the idea of one science room in every school was accepted. Consequently, these schools do not have a room big enough to be set aside for a good science room. Government regulations have not yet enforced specifications for science rooms and laboratories. A few schools, most of them in the Kathmandu valley, have been trying to convert one of the school rooms into a workable science room. Model schools with well-established science rooms are yet to be started, but efforts are being made at the Science Equipment Centre to build a model science room.

Inspection and supervision

The Secondary Education Division under the Ministry of Education has a science specialist whose job is to improve science teaching in schools. Zonal and district education supervisors are almost all non-science personnel, so they are not able to help much in supervising science teaching in the schools. Six science graduates, now undergoing training in the College of Education under a Unesco advisor, can hopefully be employed for the purpose of science supervision after the completion of their training which is mainly to help them organize science workshops and serve as instructors in the Science Equipment Centre.

Principal problems in science teaching

Problems in the field of science teaching can be broadly classified into four basic ones:

1. Meeting the shortage of well-trained teachers;
2. Framing suitable curricula, tests and manuals, and other scientific equipment;
3. Building science facilities in all schools;

4. Reforming the examination system, so that the objectives of science teaching may be effectively achieved.

The examination requirements dictate the content of the curriculum and determine the form of teaching adopted. Hence the textbooks are mostly of the 'question and answer' type, and even the best teachers, in most cases, settle for some method which will ensure that the students will have learned the right answers to the sort of questions likely to appear in the examination papers.

Other problems are: poorly paid teachers having to take up other activities in order to supplement their incomes, suitably intelligent persons not being attracted to the teaching profession, and overcrowded classes thwarting even the efforts of trained teachers.

Programmes in progress for the improvement of science education

1. The College of Education and normal school programmes have already been described, as has the one-year programme for six teacher educators.

2. Workshops for in-service teachers were first started in the year 1961 for teachers from schools designated to become multipurpose schools. Later on they expanded to accommodate other secondary schools as well. Since 1964, about 50 trainees every year have been admitted into the programme, which is only for middle and secondary school science teachers. A group of science educators from the College of Education and other colleges collaborate to impart the training. The present requirements are four terms for the SLC passed trainees and two terms for the I.Sc. and B.Sc. passed trainees. Efforts are constantly being made to base the training along modern lines, and the work is guided by a Unesco advisor.

3. Since 1965 the STEP programme is running workshops for middle and secondary school teachers. Daily lesson manuals are prepared based on a modern approach and at the same time carrying them through one grade every year. In five years they will have covered the middle and secondary levels.

SCIENCE EDUCATION IN PAKISTAN

Background

Education in Pakistan is a provincial subject, where it is in the charge of Departments of Education. The Ministry of Education in the Central Government exercises co-ordinating, policy making, and advisory authority and runs some special institutions and schools in centrally administered areas.

During the last 10 years, educational enterprise has several times been subjected to detailed evaluation. Recently, a National Commission of Education and Manpower has been assessing education, with particular reference to its adequacy, appropriateness and potential for meeting manpower needs, accelerating the pace of development, and the problem of unemployment among the educated.

There has been a distinct bias in education in favour of science and technology. Another area of concern is the quality of education, particularly at the higher levels. The aims of educational development include the provision of an educational system which would facilitate transition into an era of science and technology, and raising the quality of education at all levels so that it may properly fulfil its nation-building tasks.

In the two provinces, East Pakistan and West Pakistan, as well as in the centrally administered areas and institutions, the educational structure comprises five years of primary education, three years of middle school education, and four years of secondary education, divided into lower and higher secondary. Science education is compulsory at the primary stage, middle stage, high stage and in vocational, technical and agricultural institutes.

This article is a condensation of a paper prepared by Dr. Abdul Latif, Dean, Faculty of Agricultural Economics and Rural Sociology, West Pakistan Agricultural University, and Mr. M. A. Jabbar, Deputy Educational Adviser, Ministry of Education, Islamabad.

The present state of science education

Schemes of studies and courses have traditionally been laid down by the examining bodies: by the Provincial departments of education for grades I to VIII and by Universities or Boards of Secondary and Intermediate education, for grades IX to X. Only minor changes were made in these courses until about 2 years ago. The position detailed here conforms to the pattern as established by two National Committees in 1960. The changes currently under implementation or at planning stage are covered in subsequent sections.

Teacher training

Teachers for primary schools are trained in Primary Training Institutes or Normal Schools. The training course, originally lasting one year, is being extended to two years. Teachers for middle schools are trained in Junior Training Colleges or Teachers' Training Institutes, after secondary or higher secondary school certificate. Teachers for lower secondary schools are trained in Teachers' Training Colleges for one year after a Bachelor's degree. There is no teacher training for higher secondary schools; the minimum general qualification is a Master's degree. Training qualifications for teachers of vocational courses are currently under consideration.

Teachers for the primary and middle schools are generally prepared both in subject matter and teaching methodology. As such, they are normally expected to be qualified to teach science as well as other subjects. For the high school stage, teachers should be degree holders in science, or should have completed higher secondary education and have taken science as a special subject at the teacher training institution. There is nevertheless a shortage of properly qualified science teachers. By giving preference to candidates with a background of science for admission to teacher training colleges, by offering substantial scholarships to science graduates to attract them to the teaching profession, and by enhanced provision for science courses at degree level, the deficiency is being made up (the number of graduates in science rose from 5360 in 1963 to 9740 in 1965).

Special institutions - Education Extension Centres and their sub-centres - are charged with in-service training of teachers of secondary schools. Special independent institutions and special wings in teacher training institutions have been established for in-service training of primary school teachers.

Science at the primary level

Pupils in primary schools cover a course of elementary general science, comprising health science, physical science, elementary biology and agriculture. Emphasis in the first two years is on nature study. Separate textbooks on science are prescribed for grades IV-V. All teachers are given some training in elementary science at the training institutes, including how to perform simple experiments by using locally available materials. Three periods per week are allotted to science in grades I to V.

The teaching of general science in the primary school aims principally, through observation, experience and activity, at developing in the child:

- an understanding of his physical environment and the inter-relationship that exists in nature;
- a desire for finding out the truth, an ability to investigate his surroundings, and to report facts accurately;

Science at the middle stage

In middle schools, there is a common course of general science comprising biology and physical sciences. In addition, students have to take agriculture, domestic science, practical electricity, or one of the industrial arts. Time allocation for general science is 5 periods per week; and for practical or applied sciences, 3 periods per week. Principle objectives of the course are as follows:

- to develop a basic understanding of nature and of the forces of nature;
- to develop the habit of critical thinking and to draw inferences from observations;
- to diagnose ability in science, and to stimulate the minds of children so that scientific ability and aptitude is developed.

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Science at the high school stage

The curriculum at this stage has been diversified. Students are allowed to elect for one group of subjects out of a total of six: Humanities, Science, Commerce, Industrial Art, Agriculture and Home Economics. The most popular group next to Humanities is Science. The time allowed for general science is 5 periods a week out of a total of 45-47 periods a week.

The students taking up the Science group, do not study general science. These students take up one of the following in addition to elective physics, chemistry and mathematics: (a) biology, (b) physiology and hygiene, (c) geometrical and technical drawing, (d) geography, (e) other alternatives. The time allowed for all the subjects of this group is 18 periods per week. Before 1960-61 the elective science group was available in some regions only at grade XI and XII. Since 1961 elective science has been introduced in grade IX and X of many high schools.

The diversified curriculum also provides for agricultural and industrial arts groups. The students taking up these groups are required to study physics and chemistry as two compulsory subjects.

Curriculum and teaching materials

Textbooks are generally written by subject specialists in the colleges and universities, actual classroom teachers and teacher trainers in the subjects, chosen through open competition. These are then reviewed by competent persons and edited by subject specialists. The two provincial Textbook Boards then purchase the copyright from the authors and publish the books.

Generally, the teaching aids and laboratory equipment for school classes are manufactured indigenously and those for the upper grades are imported. However, two Science Equipment Development Centres have been set up to prepare designs and specifications of equipment and aids required for science teaching. These centres are also producing prototypes of equipment for large-scale production.

The curriculum for secondary education now stipulates that students taking up elective physics in grades IX and X will carry out experiments on measurement of length and volumes of solids; simple pendulum; density and specific gravity; air pressure; Archimedes' principle; calorimetry; lenses and mirrors. In chemistry, simple operations are prescribed, such as solution, filtration; crystalization; separation of mixtures; preparation properties of common gases, and distinction between acids and alkalis.

For the primary school level, no emphasis is given on having science rooms and laboratories. Instead, the students and teachers are encouraged to work in open air for observation of natural phenomena, collection of rocks, sand, common flowers, fruits and simple animals. At the middle stage, also, the emphasis is on outdoor activities and some simple demonstrations of experiments in general science.

For lower secondary general science, outdoor observation of phenomena, collection of specimens etc. are combined with demonstration by teachers and simple experiments by students. For elective sciences it is emphasised that the schools should have laboratory facilities for conducting the minimum number of prescribed experiments by the students.

Inspection and supervision

With the establishment of Pilot Secondary Schools offering diversified curricula i.e. multilateral courses in elective science, commerce, industrial arts, etc., the Education Extension Centres have started the nucleus of specialist supervisors in science, agriculture, home economics, industrial arts with their specialists. Similarly, in accordance with the Plan of Operation of a Unesco/UNICEF Project for assistance in the introduction of diversified courses and supply of equipment kits, two teams of specialist supervisors (each having 5 members) have been set up. Although there are no facilities for the training of science supervisors, many of the science specialists in the Education Extension Centres and those of the supervisory teams already have a Master's degree in science.

Major problems

Examination system: Changes are necessary to eliminate the current stress on memorizing, but reform of the system is still at the planning stage.

Scientific talents: New institutions have been designed to meet the needs of the talented, but no measures have been adopted for "early identification" of scientific talent.

Laboratory equipment: Owing to a rigid foreign exchange position, a shortage of equipment for laboratories, particularly for covering some of the new items of physics, is impeding reform of science teaching.

Recent developments in science teaching

Modernization of curricula

The higher secondary stage (grades XI and XII) was the first stage to be tackled. Using the talent of outstanding Pakistan scientists and benefitting from the work done in other countries, new courses were developed, new textbooks prepared and all the teaching staff given 6 weeks training. The new courses were introduced in Grade XI in the year 1967. In 1968, the modernization programme was extended to cover grade XII. In the same year, the courses written during 1967 for grade XI were revised, in the light of a review as well as comments and suggestions received. Also in 1968, new courses were developed for grade IX. The teacher trainers for this programme had previously been exposed to modern courses and had a year's experience of teaching them. Using these teacher trainers, the West Pakistan Education Extension Centre was able to organize orientation to the new courses for 3,500 high school teachers at over 30 different centres in West Pakistan in 1968.

The new courses have been introduced in all institutions for all science and mathematics students of the lower and higher secondary stages in West Pakistan.

The work still in progress relates to the production of teachers' manuals and laboratory guides, equipment lists and designs, and review and extension of the project. Preliminary work for modernization at the middle stage has also been undertaken.

As has been stated earlier, general science syllabi for grades IX and X of the schools in East Pakistan were modernized through an exercise undertaken by the Director of Public Instruction, East Pakistan, in collaboration with the Boards of Intermediate and Secondary Education and the Education Extension Centre.

A similar exercise has also been undertaken for modernizing the syllabi of elective sciences, namely physics, chemistry and biology at grades IX and X.

Besides the Teachers' Training Institutes conducting the pre-service training of science teachers, the Education Extension Centre and the Board of Intermediate and Secondary Education, Dacca, have been organizing special refresher courses for in-service teachers to use the new syllabi and textbooks of general science. In addition, an intensive short training programme for science teachers to improve the evaluation and testing of students' achievement has been organized.

With the assistance of some aid-giving agencies, several summer institutes for teachers of physics, chemistry and mathematics at the higher secondary level, were organized in East Pakistan during the summers of 1966-68. The teachers who participated in these summer institutes were supplied with modern texts, teachers' and laboratory guides as well as equipment kits consisting of a few important pieces of equipment.

Institutions for the gifted

Comprehensive high schools for the gifted, and superior science colleges are new types of institutions designed to provide education in sciences and mathematics of a level and type appropriate for the talented students. A separate cadre of staff, separate types of facilities and separate courses of studies and examination are being developed for these institutions. Substantial provision has been made for scholarships to equalize educational opportunity for talented students from all geographic areas and socio-economic groups. All aspects of the programme are being co-ordinated, and the resources are being pooled for the successful execution of the project.

SCIENCE EDUCATION IN PAPUA-NEW GUINEA

General Background

Papua-New Guinea consists of the United Nations Trust Territory of New Guinea in the north, and the Australian Territory of Papua in the south. Both Territories are governed by the Administration of Papua and New Guinea, which is responsible to the Australian Government in Canberra. It has a population of about two million people, speaking about 700 different languages. Administration is financed by a substantial annual grant by the Australian Government ($87,295,000 dollars for 1968/69) and revenue raised from taxes and duties. The total 1968/69 budget, announced in August, is $152,860,000.

The education system in outline

The school system is controlled by the Education Department of the Administration, which operates its own schools and Teachers Colleges, and controls and financially assists similar institutions run by non-governmental Christian Missions. Education's share of the 1968/69 budget is $16,541,000, an increase of $1,478,909 on 1967/68. Two types of schools are operated, a small number of 'A' schools which work on Australian syllabuses, and a much larger number of 'T' schools, which follow specially designed Territory syllabuses. The 'A' schools cater mainly for overseas personnel on short-term contracts. The 'T' schools are designed to cater for the educational needs of Papuans and New Guineans, whose future lies in the Territory, and whose wide variety of languages and cultural backgrounds require particular syllabuses. The table which follows shows the present state of schools and enrolments.

This article is a condensation of a paper by Mr. M.N. Maddock, Inspector of High Schools, Education Department, Territory of Papua and New Guinea.

Number of schools and enrolments, Papua-New Guinea 1968

	Primary	Secondary	Vocat./Technical
'A' Schools	56	3	-
Enrolment	5 789	808	-
'T' Schools	1 637	58	55
Enrolment	203 813	13 513	3 159

Primary 'T' education consists of seven years (Preparatory and Standards 1-6). There is some discussion as to whether this should be reduced to six years, in order to spread resources and make education available to more children. A primary final examination is held at the end of Standard 6, after which about half the graduates pass into high schools, some carry on to vocational/technical schools, which are being given ever-increasing emphasis, and the remainder go to work or return to their homes.

At the moment, high school courses lead to an externally examined Intermediate Certificate at the end of 3rd year, and the School Certificate at the end of 4th year. Plans are afoot to modify this system into a four year course (Forms I-IV) leading to the School Certificate examinations as the only external examination, with a turn-out at the end of Form II. The emphasis on external examinations is being steadily decreased, with much more emphasis being placed on internal assessment.

Technical schools accept students who have completed Form II at high schools, and carry them on to a standard equivalent to the school certificate at the end of 4th year.

In 1969, a senior high school is being established to take a limited number of highly selected students to 5th and 6th year. More of these schools may be set up on a regional basis later.

There are various Third Level institutions, including Teachers' Colleges controlled by the Education Department, a number of special training colleges operated by Administration Departments (Agriculture, Forestry, Health, Trade and Industry, Public Service Commission), the University of Papua-New Guinea, and the Higher Technical Institute. Entry standards vary; the

University and the Higher Technical Institute at present take high school graduates with the School Certificate into a preliminary year, before commencing degree and diploma courses.

In some areas (e.g. New Britain), there is almost 100% enrolment in Primary schools. In other areas such as the Southern Highlands, where Administration control is relatively recent, there is a much smaller percentage (about 15%) and some remote areas have no schools at all.

All teaching is carried out in English, which is a foreign language, first met by most children when they enter Preparatory Class at Primary School, except in the regions where schools have been established for a long time. All 'T' schools are now operating on syllabuses constructed within the Territory.

In primary schools (both Mission and Administration), of approximately 5 680 teachers in 1968, about 1 000 were recruited from Australia and elsewhere. In secondary schools (high schools), of approximately 885 teachers, only about 130 were Papuans and New Guineans. Primary teacher trainees undergo a two-year course from Form III and above. The first graduates of the new Teachers College at Garoka completed their three-year course in 1968 and are joining secondary school staffs.

Science education

Natural science has been part of the primary curriculum since the early 1950s, being allocated one or two periods per week, and has gradually evolved from an almost pure nature study, to a natural science course with increasing emphasis on practical work and the physical sciences. The emphasis on the subject has not been strong, however, one of the major handicaps being lack of adequate background on the part of the teachers. Major revisions of the course were undertaken in 1966 and 1968.

Science began in High Schools in 1961, with Territory syllabuses being introduced for Forms I and II in 1966, and for Forms III and IV in 1968. Science is a compulsory part of the high school course and is allocated five or six periods per week.

No special facilities or equipment have been provided in the past for primary science, or at the primary teachers colleges, but all high schools are provided with laboratories and equipment as part of their normal development. In the larger established schools, consolidation of laboratories is being undertaken, with the eventual aim of providing a laboratory for each 30 periods of science in the school.

Qualified science staff have always been difficult to obtain, and the Territory is facing an acute shortage of science teachers: in 1968, only 43 of 123 science teachers were qualified. A two-year special Junior Secondary science teacher training course is conducted at the Australian School of Pacific Administration (A.S.O.P.A.), and science is one of the special subject areas at Goroka Teachers College, but the graduates from these courses will not fulfill Territory requirements for years to come.

The problem of developing a suitable syllabus

Imported syllabuses have served their purpose in the Territory scene, and it is difficult to see how a start could have been made in any other way. It is obvious that a sophisticated science course, designed for people living in a technological environment, with access to adequate experiences in their everyday life, is not suitable for Papua-New Guinea, but what should constitute a suitable course? The majority of students come from a rural, subsistance culture, where magico-spiritual beliefs play an important part.

Counting systems vary among cultural groups, from a base 2 in many highland areas, to a base 5 in many coastal and island areas of Papua and occasionally a base 10, as found on Rossel Island. The need for any form of measurement is quite limited, and there are no clearly developed concepts of distance-time relationships. Lack of appropriate experiences in the cultural background, with associated problems of awareness, needs and motivation, and different ideas of causality, lead to difficulties in developing essential scientific concepts.

J.R. Prince, of the University of Papua-New Guinea, has conducted a preliminary survey into the concept of conservation in Territory school children, and his results indicate as has been found elsewhere in other pre-literate societies, that conservation is developed in Papuan and New Guinean school children considerably later than in European children. In one of his papers on his survey, he referred to four problems which he regarded as in need of urgent examination, namely: (1) lack of manipulative skills; (2) problems in logical operations; (3) conceptual problems, particularly in conservation of physical quantities; (4) causality problems. [1]

Basic scientific principles are the same wherever they are taught. While this gives common ground to all syllabuses, however, the selection of which units and which techniques are appropriate to use as vehicles for developing a wholly novel approach to life is not an easy matter.

Territory pupils are very keen on their school work, and are willing to spend vast amounts of time rote-learning information from notebooks and textbooks, in order to pass an examination for a certificate. The mere assimilation of knowledge about science, however, does not result in a behavioural change in the pupil from a traditional mode of thinking to one which will fit him to live in the modern scientific world.

How the territory is tackling the problem

The Syllabus Committee drawing up the new Territory High School Science Syllabus decided that a new angle was needed to produce a flexible syllabus allowing for the wide ranges existing in stages of sophistication of the pupils, local environments, local needs, teacher qualifications, and teacher interests. Science was analyzed down to a structural relationship of what are considered to be the basic concepts common to all branches, and grouped under the following headings:

- Mathematical Ideas (e.g. number and relationships)
- Physical Quantities (e.g. distance, time, work concentrations)
- Organization of the Universe
- Attributes (properties or characteristics)
- Organization (structure)
- Classification (organization into convenient groups on the basis of attributes)
- Discrete Units (recognizable levels of organization)

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[1] Prince J.R. : "Bottlenecks in Papua-New Guinea Science Teaching", Papua and New Guinea Journal of Education, September 1967.

- Processes of re-organization (changes in the form of matter involving energy)
- Processes of observable movement (e.g. cycles, vibrations)
- Regions of influence (e.g. fields)
- Conceptual models and their representation (Principle of developing a model based on observation)

Any subject matter of Science can be dealt with in such a framework, and the principle of the new syllabus is to treat selected subject areas directly appropriate to the pupil in his own area, to bring out these basic principles and their relationships.

The key point in the structure is the student as an observer. The critical observation of properties should lead to ability to describe properties. This involves the need for specific tools of description - how big?, how fast?, how hard? - leading on to the concept of physical quantities. This in turn leads to measurement and the noting of relationship between properties and to changes in properties, to the recognition of a level of organization on structure, the concept of classification, and the need for selecting discrete units to work with.

These lead to an intellectual idea, or conceptual model, based on observation, which can then conveniently be represented in some form by symbols. This model is only good as the observations on which it is based, and can be modified by further field observation.

For the first two years a broad area of subject matter is listed. In the third and fourth years, no specific body of subject matter has been prescribed, the teacher being allowed to select suitably linked and balanced units from suggested programmes. The syllabus has been divided into three areas - Basic Core, Developmental Area and Research Area. The basic core carries on through all four years of the syllabus, the latter areas being tackled in addition during third and fourth year. In the basic core, a balance of physics, chemistry, biology and geology topics are dealt with to bring out basic concepts.

Typical of the type of approach expected is a series of activities suggested to bring out the principles of classification. Pupils will first collect items at random and sort them into sets on the basis of criteria they select themselves, from the observed attributes. Later they will be asked to define the limits of a set of items (e.g. leaves), and discriminate distinguishing properties. These properties are then used to make a binary key and a set of punched cards, which can then be used in classification of further specimens.

The important emphasis is on the principles involved, and not on a traditional approach of learning vast quantities of information about long-accepted classification systems. Selected traditional systems will be examined only as being useful classifications based on the principles developed.

The Developmental Area is aimed at giving the pupil a detailed appreciation, and a little historical background, of at least one technological influence and one influence drawn from the natural sciences, which closely affects the life of the people in his district.

Tales abound in the Territory of the abuse of vehicles, radios, watches, and other appliances, by people who fail to appreciate that such devices are delicate pieces of machinery requiring care and maintenance, and not just pouri pouri (magic) boxes that perform when a button is pushed. Crowds flock to the out-patients wing of Territory hospitals to receive the magic "shoot" or "medicine" that cures all pains and illnesses, no matter how minor. Villagers listen to the agricultural officer's talk about agricultural methods, but still think the old men know best. It is hoped that this area of study will go a long way to reduce tendencies towards "cargo" cult beliefs, to improve attitudes to safety factors, to develop an appreciation of the need for and the tools for achieving progress.

Many schools have chosen the internal combustion engine as their theme, varying from motor vehicles in towns, to outboard motors in some coastal schools. One school is building an Amateur Radio station (radio being vital to the functioning of Territory outstations), and many girls' groups are dealing with the science of fibres and sewing machines. One school is building its whole developmental study around the station hospital - from X-ray machines and sterilizing plants to disease control. Agricultural studies around crops and animals are popular for the natural science section of the Developmental theme.

To keep the systematic mode of enquiry developed from the Basic Core, a series of fourteen questions has been framed as a guide to the Developmental study. Some of these are:

- Can any movement be seen or experienced? (a) Can the forces, fields and energy be identified? (b) Is there any pattern shown by the movement?

- Are there processes (chemical or physical) which can be observed? Can the energy which causes this be identified?

- Can the rate of any process, movement or change be measured? If so, how?

- Can the area of study be broken up into discrete units?... how can they be defined?

- How are these units distributed - evenly or unevenly? ... any special concentrations?

- What properties are shown by these units?

- What distinguishing properties enable classification?

- What structure or arrangement can be seen, or deduced from properties? Can broad patterns be seen therein?

- What relationships are there - (a) between cause and effect? (b) between structure and function?

- What relationships can be found by measuring or experimenting?

During third and fourth year, pupils spend fourteen weeks applying their mode of enquiry to trying to solve a problem involving unknowns, with the aim of developing an appreciation of how scientists make discoveries. The pupils are actively engaged in recording observations and measurements on the problem, and looking for relationships. The projects may be individual or group efforts, and even institution-assisted.

Projects being undertaken by schools include water table and creek flow studies, disease patterns, digital formulae and digital hairs in village groups, percentages or parasitism in poinceana moths, colour preferences in food, growth rate and fertilizer studies and reef repopulation experiments. As a result of a recent seminar, it is likely that some schools will be undertaking alkaloid testing in territory medicinal plants.

A syllabus such as this one must bring about a change in the form of pupil assessment. At first, the Basic Core will be externally examined by a short objective test of understanding of principles. The schools themselves will carry out progressive assessment by similar objective tests, longer written tests, practical tests, and the pupil's work on projects.

A strong programme of pre-service and in-service training is needed to bring teachers to the new way of thinking. While many are enthusiastic, others are suspicious of the changes in the examination system, believing that standards are best maintained by identical testing.

Laboratories

A new laboratory design goes into operation this year, being a large room in which there is a work bench around the walls provided with sinks, water and gas points. The centre of the room is to be equipped with movable trapezoid tables, which can be paired together to make a hexagonal working space for a group of 4-6 students, and will be used for ordinary classwork, as well as practical work. The preparation room incorporates a small wood-metal work unit for repair, maintenance, and making of equipment from local materials. Mobile trolleys will be provided to enable easy preparation and transport of equipment for laboratory periods. The laboratories are to be built in pairs, with the preparation room between.

Science in primary schools

With the new secondary course under way, attention has been turned to strengthening Primary Science. The syllabus is being designed to underwrite the high school course; one main emphasis will be on providing experiences which are lacking in the cultural background of the students. UNICEF is providing equipment kits for primary science.

Papua-New Guinea has made good progress in Science education despite limitations, and is on the threshold of an exciting new era. The United Nations assistance in equipment, funds and staff is making a valuable contribution to this project.

SCIENCE EDUCATION IN THE PHILIPPINES

General structure and teacher training

The Philippines Public Schools System consists of a six-grade elementary school and a four-year high school. The elementary level (grades I-VI) is divided into a four-year primary school and a two-year intermediate school. In some rural areas only the primary school is present.

Most elementary-school children are in the public schools, while most high school students are in private schools. Public examinations do not feature very largely in the elementary and secondary school stages, although internal class tests, mostly of the 'objective' type are commonly carried out in the schools. The better known private schools, however, select their students on the basis of an entrance test, and the Philippines Science High School at Quezon City selects its students on the basis of country-wide scholarship tests.

Teacher training is a vital function of the school system to provide for effective instruction. For this purpose there are nine regional normal schools strategically located in the country and supported by public funds. Nineteen state colleges and universities and eleven vocational schools also provide teacher training. Most prospective teachers, however, are trained in 238 private institutions. (Figures relate to 1965).

Under the present set-up, elementary and high school teachers undergo four years of pre-service training. Prospective elementary school teachers formerly took from 6 to 9 units each of science and mathematics courses while in training. Now there is a concentration scheme whereby elementary student-teachers

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This article is a condensation of a paper by Dr. Liceria B. Soriano, Assistant Director of Public Schools, Department of Education, Republic of the Philippines.

may take more courses in their chosen fields of concentration (e.g. science). Prospective high school teachers may major in one or two subject fields.

The science teachers in secondary schools hold Bachelor of Science in Education (BSE) degrees (major in General Science, Biology or Physics), a four-year degree course after high school. There are practically no chemistry majors, since the subject is relatively new in the schools.

The last several years have seen the prosecution of an intensive in-service training for all teachers in science and mathematics. These programmes have been financed by the National Science Development Board (NSDB) and run in co-operation with the Department of Education. Possession of certificates of attendance (if the training programme is recognized by the Bureau of Public Schools) entitles teachers to salary increments and higher positions.

The Philippines Association of Science Teachers is a national association of teachers which assists the Bureau of Public Schools in upgrading science instruction. This association organizes seminars, workshops or conferences in cooperation with the Bureau of Public Schools as well as publishing a quarterly journal on science.

Science curriculum and content

The science curriculum, like any other, is formulated by the Board of National Education. The revised science curriculum (1957) is summarized in the following paragraphs.

Elementary science is taught from Grades I to VI in the elementary schools as a required subject. It comprises science and health with various arrangements in the allocation of time between these related subjects. Elementary science has progressed from the traditional nature study and now draws from both the biological and physical sciences, including aspects of earth science. The new curriculum materials developed recently stress such science processes as observation, description, classification, measurement, inference, hypothesis, graphing, controlling variables and experimentation. The content includes three major topics: (a) living things (b) matter, energy, and motion (c) earth and space.

Articulation between elementary and secondary science has been sought since 1962 when a national workshop on articulation was attempted. Today, for instance, workers developing the elementary science curriculum are looking to the Philippine BSCS Adapted Biology Course* and the evolving programmes in physical science for guidance on content and methodology.

There are two types of secondary schools: general high schools and vocational. The latter are in three categories: (a) agricultural (b) fisheries and (c) trade schools. The general high schools have two kinds of curriculum: (a) college preparatory and (b) vocational education. In addition, a special science curriculum is found in many large city schools.

General Science I and II are offered in all categories of secondary schools. These courses consist of twenty-three major topics designed to be taken in increasing depth in the first and second years.

In the general high schools, biology is offered in the college preparatory curriculum and in the special science classes, as well as in fishery and agricultural courses. Traditional courses in secondary school biology emphasize morphology and physiology in relation to health and hygiene; there is some anatomy and taxonomy. Except for schools that are using the adapted BSCS biology books, very few include ecology in their courses, as biology teachers do not usually have training in ecology or conservation.

In the general high schools, applied chemistry is a required subject for third-year students in the vocational education group, while in the college preparatory curriculum, general chemistry is an elective for fourth-year students. In the special science curriculum, chemistry is required. Most courses of study in chemistry have too much breadth of content while lacking in depth.

Physics is given, with varying time allotments, as a one-year course in the fourth year of nearly all types of secondary schools. The topics included in the high school physics course are: mechanics, heat, electricity and magnetism, sound, optics and light, and atomics.

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* An adaptation of the Biological Sciences Curriculum Study produced for Philippine High Schools by the Science Education Centre, University of the Philippines (see page 65).

Textbooks, equipment and facilities

Preparation of textbooks is done on a competitive basis, the competing books are evaluated by a committee, and the final selection of the textbook to be used in public schools is made by the Board of Textbooks. The Elementary Science textbooks now used were adopted in 1962, while those for secondary schools were last revised in 1961-1962.

Laboratory classrooms complete with benches, gas and running water facilities and chemicals are found only in the bigger schools, mostly in the Manila area. These high schools also have modern teaching aids.

It would be a very rare elementary school that would have a complete laboratory room, its own movie projector, filmstrip projector or overhead projector. Educational television is limited to a very select group of Catholic colleges with elementary schools and the programmes are mainly in language and in arts. All divisions (provinces) have each received a few micro-projectors, but these are hardly used for several reasons: (1) they require electricity which most schools do not have and (2) fresh mounts are difficult to prepare and project through micro-projectors.

Several thousand science kits have been distributed to elementary schools but many more thousands of schools are still without kits. There is considerable interest in improving equipment from inexpensive materials utilizing the Unesco Sourcebook for Science Teaching, [1/] which is given free to teachers who attend five-day construction workshops. Recently, the Asia Foundation has distributed a set of physical science kits to groups that are willing to organize and undergo training.

Major problems

Insufficient equipment, materials and books: Among equipment, the microscope presents the greatest problem, being too expensive for many schools to have in sufficient numbers. Also, laboratory supplies, and new books and references are needed, particularly with a view to suiting a science course to the specific conditions in a school.

1/ See reference on page xix.

Teacher education: Most of the attempts to introduce new materials, new approaches and new developments in science teaching are directed to in-service education of teachers. What is needed is the integration numerous new aspects of science teaching into the pre-service programmes of teachers. Teaching science as enquiry needs further exploration - how are we going to teach future teachers to use this method?

Need for local studies on teaching-learning: Studies on the various factors and conditions that affect teaching-learning in our own setting should provide data that could guide curriculum innovations and improve teaching methods.

The Science Education Centre

The Science Education Centre was organized in 1964 as a part of the University of the Philippines. In co-operation with the Department of Education and the National Science Development Board (NSDB) it has the initial purpose of developing curriculum materials (student texts, laboratory manuals and teachers' guides) in science and mathematics for the elementary and secondary school levels. The Centre is organized into five work groups - Elementary and General Science, Biology, Physics, Chemistry and Mathematics - each under the chairmanship of a professor of the University of the Philippines working full-time at the Centre. The members of these groups meet from time to time and undertake the writing and reviewing of manuscripts. Experimental editions of four high-school courses (two in mathematics and two in science), and three courses in elementary school science were ready for try-out in selected schools starting July, 1967. Work has continued on the development of the other science and mathematics courses, but a major activity of the programme since then has been the evaluation of the first set of courses.

The Science Curriculum Development Study

The development of materials for Elementary and General Science has proved to be the most time-consuming, and in order to complement the work of the Science Education Centre in this field, the Bureau of Public Schools, in co-operation with the NSDB and the Peace Corps in the Philippines, have organized a Science Curriculum Development Study. The purpose of this project is to modernize the curriculum materials on General and Elementary Science, but the Bureau of Public Schools project has concentrated particularly on developing teachers' guides. The materials of both projects are oriented in rationale towards the AAAS: Science - A Process Approach [1] but the developments of the lessons and activities, are mostly indigenous.

As a step towards improving the quality of pre-service training for science teachers, the Science Education Centre, in co-operation with the University's College of Education, plans to offer a series of graduate courses (Master of Arts in Teaching) covering the sciences and mathematics for staff of teacher training institutions for the period 1969-75. The courses will mainly deal with the new curriculum materials.

Regional Science Teaching Centre

Complementing this programme, the NSDB, the Department of Education and the University of the Philippines have recently formulated a long-term plan to establish up to twenty Regional Science Teaching Centres. These centres will provide up-to-date pre-service and in-service training programmes for school science teachers, will organize meetings and conferences, and will provide advice and information to schools on the setting up of science libraries, and the development and use of new materials. The staff of the Centres will be trained in graduate programmes at the Science Education Centre. The first Regional Science Teaching Centre is being established in the Southern Philippines. Financing for these new developments is being provided by the NSDB together with UNICEF and the Ford Foundation; some technical assistance is provided by Unesco.

Apart from these major developments, a number of special projects covering important but limited areas are underway.

Ateneo de Manila University Programme. This University, with assistance from the Ford Foundation, has organized an educational television programme which operates in the Greater Manila area. This includes a series of programmes based on PSSC [2] physics. The Chemistry Department of the University has also made a

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[1] American Association for the Advancement of Science. Science; a process approach. Washington, D.C.

[2] See references on p. 65.

Philippine adaptation of CBA[1/] chemistry, which is being used in a number of private schools.

National Study Group for Chemistry Teaching. This Group, which includes both university and school teachers, as well as representatives from the Department of Education, the NSDB and industry, works in collaboration with the National Commission for Unesco in the Philippines and the Unesco Regional Chemistry Teaching Project in Bangkok, Thailand. The Group organizes workshops and training programmes with visiting lecturers. It is currently working on a new chemistry curriculum for both general and vocational high schools.

Production of science teaching equipment. Increasing attention has been given to meeting the need for adequate science teaching equipment in the schools. The Don Bosco Technical Institute, near Manila, produces locally-made science equipment for private schools on a commercial basis. Recently, a Physics Equipment Centre has been established at the University of the Philippines with assistance from the Colombo Plan, and works in co-operation with the NSDB and the Bureaux of Public Schools and Vocational Education, in making physics equipment for general and vocational schools.

1/ The Chemical Bond Approach, Earlham College, Richmond, Indiana 47375, U.S.A.

SCIENCE TEACHING IN SINGAPORE

Background

The school system: The school system in Singapore is made up of six years of primary, four years of secondary, and two years of post-secondary education. The grades of the primary school are referred to as primary-1 to 6, those of secondary school as secondary-1 to 4, and the post-secondary as pre-university-1 and 2. The average child in Singapore normally completes six years of primary and four years of secondary schooling. Abler pupils continue for an additional two years in the pre-university classes, which are preparatory to the universities and colleges. Most schools operate on a two-session basis: one session in the morning and another in the afternoon with a different set of pupils and teachers.

Language streams: In keeping with the accepted policy of multilingualism, each pupil is required to study at least two languages from among the four official languages (English, Chinese, Malay and Tamil) which are taught in the schools. Placement in a class unit of a school is based on the first language, and classes within a school having a common first language are referred to as a stream. A school with two or more such streams is known as an integrated school. The first language is generally the language of instruction of the stream but, whatever the stream and the first language, the aim is to have science and mathematics taught in English in all the schools.

Examinations: Throughout the whole school system there are three external examinations conducted by external bodies: the Primary School Leaving Examination (PSLE), the School Certificate (SC), and the Higher School Certificate (HSC) examinations. The SC and HSC examinations of the English streams are conducted by the Cambridge Local Examination Syndicate (England),

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Prepared by: Mr. Tan Choong Yan, Chairman, Science Teachers Association of Singapore.

while similar examinations of the other streams and the PSLE are conducted by the Examinations Division of the Ministry of Education, Singapore.

Types of schools: There are three types of secondary school: academic, technical and multipurpose. The multipurpose school is a combined version of the academic and technical schools; some have a commercial stream. Under a recently introduced scheme, all schools have a common curriculum for the lower secondary classes. The upper secondary classes of the different types of schools have different curricula. In addition to languages and a few core subjects, the academic schools offer subjects in the liberal arts and pure sciences, the technical schools offer subjects with a technical and engineering bias such as woodwork, metalwork, technical drawing and engineering science, while the commercial streams of the multipurpose schools concentrate on commercial subjects such as typing, book-keeping and accounts, and omit science in the general education programme.

Science Programmes

Science courses: The school science courses are arranged vertically right through the system from primary to secondary and pre-university. Thus, there is primary science for primary, general science for lower secondary, and a variety of two-year courses for upper secondary and pre-university classes.

The primary science course consists essentially of nature study during the first two years. Elements of the physical sciences are introduced in the third year and taught during the remaining years of the primary science course.

General science is prescribed for the lower secondary classes in all types of schools, and is usually studied as three different units of physics, chemistry and biology in each of the two years, rather than as an integrated course.

Selection and streaming occurs at the end of Secondary-2. Selection for the various science courses available beginning in Secondary-3 is based more on ability than on choice. Two groups of ability are usually distinguished in all types of schools. Only pupils in the higher ability range can offer two sciences at the School Certificate Examination.

The pupils in the top ability group of the academic schools may pursue a course either biased toward the liberal arts, with subjects like history, geography and literature, or biased toward the sciences, with two science and two mathematics subjects. The higher ability pupils in the technical schools invariably follow a course with an engineering bias, and also take two science and two mathematics subjects. The combination of science subjects available to them are shown in Table I. The lower ability pupils in both types of schools take only one science subject.

Table I. Science Courses for Top and Lower Ability Groups

Ability Group	Academic School	Technical School
Top	Physics and chemistry or Biology and physical science	Physics and chemistry or Engineering science and physical science
Lower	Physical science or General science	Physical science

There are three streams in the pre-university classes: Arts, Science and Engineering. At present, students in the Arts stream do not take any science subjects and students in the other streams do not take any Arts subjects, but this over-specialization will be rectified in the future. The science subjects available in the science and engineering streams are shown in Table II.

Table II. Subjects for the Pre-U Science and Engineering Streams

Science Stream	Engineering Stream
Physics	Physics
Chemistry	General mathematics
Biology	Pure mathematics
Botany	Applied mathematics
Zoology	Chemistry
General mathematics	Technical drawing
Pure mathematics	Metalwork
Applied mathematics	

The pre-university may take either three subjects at principal level and one at subsidiary level, or two at principal and two at subsidiary level. In addition, all students have to take the compulsory General Paper. In exceptional cases, students may be allowed four subjects at principal level.

The number of periods per week allocated to science teaching at the different grade levels varies only slightly among the schools, and for the various science courses it ranges from 3 periods in primary-1 to 8 periods for a principal subject at the pre-university level. Each period is of 30 to 40 minutes' duration.

Facilities for science teaching: On the whole, the secondary schools are well-provided with laboratories. The laboratories, large enough to accommodate a maximum of 40 pupils, are well-equipped with proper furniture, apparatus and instruments for the teaching of the whole range of science subjects. Primary schools have no laboratories. While ample funds are available to the secondary schools for meeting the recurring cost of science teaching, it was not until recently that similar but lesser sums were made available to the primary schools. In a few primary schools a classroom has been set aside specially for science teaching. Equipment and apparatus are not really adequate, and in most primary schools the science teachers have to improvise their own apparatus and collect their own materials. Generally, most primary and secondary schools have science gardens except those located within the city and built on small plots. Some of these gardens, maintained with enthusiasm, provide a variety of both botanical and zoological specimens for study, while other gardens are less well utilized.

Film projectors and the epidiascopes are standard equipment in secondary schools, and film-strips and slide projectors, overhead projectors and film-loop projectors are also used in some schools. Teachers still find difficulty in obtaining suitable films, however, the only films available being the few belonging to the Teachers' Training College, those available for loan by the information departments of the foreign embassies, and some from public relations departments of a few industrial firms.

Educational television (ETV) is one modern teaching aid which has been developed. Programmes for most of the subjects, including science taught at the lower secondary level, have been prepared locally, and are televised throughout the year, each programme being repeated twice a week. Teachers' guides giving notes on the aim of the lesson and a summary of the programme are distributed. The notes also provide instructions for teachers on how to prepare the pupils for the programme, provide background information on the topic and give suggestions of possible follow-ups to the lesson. Although the programmes are directed at present only to the lower secondary classes, ETV has become an integral part of science teaching at this level.[1]

Methods of science teaching: There is a strong emphasis on practical work, and teachers, especially in the secondary schools, adopt the practical approach wherever possible. The organization of laboratory work includes demonstrations by teachers and pupil participation in groups or in pairs. Generally, more demonstrations are used at the lower levels, whilst pupil participation is a common feature in the upper secondary classes. The nature of the experiment and its complexity, the experience of the teacher in handling large numbers of pupils working simultaneously, and the dexterity of the younger pupils are some of the factors that determine the type of laboratory organization adopted by the teacher. Pupils are given instructions for the conduct of traditional types of experiments and are allowed to carry out the experiments, make observations and draw conclusions. At the end of each experiment they are required to write in a record book the aim of the experiment, a description of the procedure used, the observations made, any calculations made, and conclusions drawn. The experiments are of the preparation, examination, observation and verification types. They are thus exercises in training of ability to interpret instructions, manipulate equipment, and make correct and precise observations. Although numerous published practical workbooks are freely available on the market, many teachers prefer to prepare their own experimental job sheets and cyclostyle them for their pupils. In most cases these prepared scripts of experimental assignments are made to modify the traditional and introduce new approaches. This practice shows a strong desire to innovate and adapt modern ideas of science teaching.

1/ Refer to: Bulletin of the Unesco Regional Office for Education in Asia, Vol. II, No. 1 (September 1967) : Widening horizons of Education in the Asian Region. Bangkok, Unesco, 1967. 83 p. pp. 61-67.

Modern methods: Most science teachers are aware of the various science programmes aimed at improving science teaching and learning that have been developed in the more progressive countries throughout the world. Several teachers have been abroad, mainly to the United States and the United Kingdom, to study modern trends and techniques of science teaching. Many teacher trainers are staunch proponents of the new methods of science teaching by the discovery and inductive approaches. In the lower secondary levels, where science teaching is not restricted by a common examination, a number of teachers are trying out the methods in a limited way. At the higher levels, many problems are encountered in any attempt to adopt the modern method within the existing system of repressive external examination, a rigid curriculum, and an uncompromising attitude towards educational achievement. Great importance is attached to passing examinations with high grades, so much so that teaching procedures tend to be examination-oriented. Teachers are judged by the performances of their pupils at examinations. As a result, teachers are compelled to coach rather than teach. Science curricula are very extensive and, to satisfy the examination objective, coverage of the syllabus becomes a necessity. Furthermore, the traditional pattern of examination questions does not encourage the use of new methods of science teaching. Under these circumstances, science teachers, especially those preparing pupils for the external examinations, are unable or reluctant to adopt the new methods. Now, however, the Ministry of Education is taking active steps to overcome these difficulties and to introduce modern science teaching methods in all the schools.

SCIENCE EDUCATION IN THAILAND

Background

Elementary (primary) education is compulsory, and is divided into two sections: Lower Elementary Education (Prathom I-IV) and Upper Elementary Education (Prathom V-VII).

Secondary education takes individual differences into consideration. It is therefore divided into two streams: the general stream and the vocational stream.

In the general stream, secondary education implies five years of study: three lower forms (Mathayomsuksa or M.S. I-III) and two upper forms (M.S. IV-V). Those who have completed the two upper forms are qualified to apply for admittance to institutions of higher education.

For the vocational stream, schools arrange courses of various lengths from about one to three years, depending on the character of the trade or profession to be taught. Some of the courses may require as foundation the three lower forms of the general stream of secondary education.

The supply of school teachers comes from various types of institutions. The 25 teacher training institutions (teachers' colleges) are the major source of supply, but other important sources are the College of Education in Bangkok and the Faculty of Education at Chulalongkorn University. The main types of teacher training qualifications and courses are as follows:

1. Elementary Education Certificate: A 2-year course at a Teacher Training School. The qualification for entry to the

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This article is based on a report prepared by Mr. Sanan Sumitra, Under Secretary of State for Education; Dr. Bitak Raksaboldej, College of Education, Prasarnmitr; Mrs. Songsi Chutiwongse, Science Supervisor, Dept. of Teacher Training; Mrs Salee Sukapinda, Science Supervisor, Dept. of Secondary Education, Ministry of Education; and Dr. Sunt Techakumpuch, Asst. Professor, Faculty of Science, Chulalongkorn University.

course is completion of grade 10 (M.S. III). Holders of this certificate can teach up to grade 7 (Prathom VII).

2. Secondary Education Certificate: A 2-year course at a Teachers' College. The qualification for entry is completion of grade 12 (M.S. V) or holding of Elementary Education Certificate.

3. B. Ed.: A 2-year course after Secondary Education Certificate at a College of Education or a 4-year course after grade 12 (M.S. V) at a College of Education or the Faculty of Education, Chulalongkorn University. B. Ed. may also be taken as a 1-year course at Chulalongkorn University after another bachelors' degree.

Science in the Elementary Schools

In Lower Elementary Education (grades 1-4), elementary science is taught for 3 hours out of a total of 25 class hours per week. Topics for study in these grades are:

Plants
Animals
Non-living things (soil, rocks and minerals)
Change
Weather
Natural phenomena
Natural forces

For Upper Elementary Education (grades 5-7), science is allocated 3 hours from 30 class hours per week. Topics are:

Weight and measurement
Living things
Matter and energy
Natural forces
Information on science

In the last topic area pupils are intended to learn about the progress of science and events connected with it.

In the teaching of science, scientific method has a place equal in importance to that of knowledge and understanding. Using the scientific method includes defining the problem with its limitations, collecting and recording relevant accurate facts, using a hypothesis to explain the facts, and testing the hypothesis to see whether or not it solves the problem.

The syllabus also mentions that extra-curricular work should be encouraged. Teachers are asked to make use first of familiar objects in the pupils' immediate environment for study, and then to select unfamiliar objects. The Elementary Education Syllabus also emphasises that, in teaching science, the conservation of natural resources should always be brought to the attention of the pupils. Teachers are asked to give advice and suggestions as to how their pupils' knowledge of science should be applied to everyday living.

Science in the Secondary Schools

Lower Secondary Education covers a period of three years (grades 8-10). In the General stream, there are usually 30 hours of teaching per week, whereas in the Vocational stream there are 35 hours. In both streams, however, science is taught for 3 hours per week, covering the following topics:

Grade 8 (Mathayomsuksa I):

- Earth
- Water
- Air
- Sun
- Living things
- Electricity in the atmosphere
- Magnetic force
- Weight and mass
- Preservation of resources
- History of science

Grade 9 (Mathayomsuksa II)

- Natural food resources
- Relations between living things
- Mineral resources
- Combustion and fuel
- Heat in daily life
- Nature of water
- Atmosphere
- Light
- The Milky Way
- Nature of electricity

Grade 10 (Mathayomsuksa III)

- Fertilisation and reproduction
- Weather
- Machines
- Chemical substances
- Science helps to make progress
- Sound and hearing
- Lighting at home
- Simple visual instruments
- Communications and transportation by electricity

The syllabus stresses that there should be sufficient practical work, and applications should be through experimentation, simple construction or calculation.

The syllabus for Upper Secondary Education provides for two years in the general stream, and three years in the vocational stream. Each week consists of 30 to 35 class hours.

Science is taught in the general stream as follows:

Science course : Science (physics, chemistry, biology) - 8 hours per week
Laboratory work - 2 hours per week
Arts course : General Science - 4 hours per week
General course : General Science - 4 hours per week.

Students in the general course may have the opportunity to take some vocational subjects, and in this case they may also elect to study two of the subjects, physics, chemistry, or biology - for 4 hours per week in place of General Science. Science subjects are not specifically included in the syllabus for the vocational stream.

The General Science syllabus covers topics in biology, chemistry, physics and meteorology, and includes topics such as atomic energy, waves of various energies, industry in Thailand and others.

Students in the science course are required to select four from the following five courses: three courses in physics (mechanics; heat, light and sound; electricity and magnetism) one course in chemistry and one course in biology. In addition, students select two of the following laboratory subjects during their two-year period in the science course of the general stream: mechanics; heat, light and sound; electricity and magnetism; chemistry; biology.

Problems

Some of the aims of science teaching in the elementary schools are to help the pupils to have an interest in their natural environment, to appreciate the cause and effect relationship in science, and to use their acquired knowledge to improve their own way of life and that of their community. At the secondary level, the aims are as listed on the next page.

1. To develop an understanding of the principles and theories of science and to acquire skills in handling scientific apparatus so as to form a basis for further studies.

2. To enable students to utilize some of their knowledge of science in certain occupations.

3. To develop an understanding of the environment and the scientific principles which are useful to life and to peaceful living, and to know how to apply the scientific method in their daily living.

4. To cultivate skills for applying the scientific method in solving problems.

5. To develop in students a scientific attitude.

6. To provide knowledge of the conservation of natural resources.

It may be stated that science education at all levels in Thailand has yet to advance considerably to reach the goals specified in these objectives. The present slow progress has much to do with the age-old problems of shortage in personnel, equipment, and material, which stem from insufficient funds.

Examples of Improvement Programmes

A major activity which is expected to have some effect toward reforming science teaching is the Comprehensive School Project of the Department of Secondary Education, Ministry of Education. The main aim of this programme, which has been in operation since 1966, is essentially to provide an opportunity for the student to concentrate on the study area in which he is most apt. The plan covers from the beginning of the lower secondary school up to the completion of the higher secondary school level. Approximately one million U.S. dollars will be allotted to science teaching, of which about three quarters will be spent on buildings and laboratories, and the rest for equipment and other material. A science teaching centre has been created in connection with this project, mainly to improve science teaching through in-service courses for teachers and the distribution of information. As a consequence of this programme, a science curriculum reform programme has been initiated, covering the lower secondary school curriculum so far. It is intended that the upper secondary school curriculum will be covered in due course.

Thailand has also been the host to the Unesco Chemistry Teaching Project. This started in 1965 in the Faculty of Science at Chulalongkorn University as a regional project, and involved consultants from Australia, Europe, and the U.S.A., working with university and school chemistry teachers from Asia to produce new curriculum materials. It is now a Unesco-assisted project for Thailand, but participants from other countries work at the project from time to time. The programme also includes training courses for school teachers. Arrangements have now been made to expand the scope of the project to include physics as well as chemistry.

The Government is also contemplating the establishment, with assistance from the United Nations, of a national centre for science education. It is envisaged that this centre will carry out research and development covering subject matter, instructional techniques and media, teacher training, and production and maintenance of science teaching equipment.

In-service courses for science teachers have been conducted since 1950 by the Ministry, with the Science Society of Thailand as co-ordinator. University personnel are involved, and assistance has been provided by Unesco/UNICEF, and the Colombo Plan and USAID.

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SCIENCE TEACHING IN THE REPUBLIC OF VIET-NAM

Present Status of Science Teaching

The teaching of science at the first level, which was completely revised in 1967, has a purely practical and local character.

At the second level, science teaching has as a goal to advance the scientific evolution of students to the level of that in other countries.

At the first level, science is taught by means of lessons in direct observation. Science is a compulsory subject for all pupils in all classes in the proportion of one tenth of the general curriculum. However, a particular qualification in science is not expected for the primary school teachers. At the first level, all teachers are required to build up an individual school museum, and to contribute toward providing the school with a museum as complete as possible.

Each teacher is required to teach science by the direct observation method; by guiding the pupils to observe in as detailed a way as possible the things which are in their environment.

Curriculum and Teaching Materials. A special Commission was appointed by the Department of National Education to draft a new curriculum, which went into effect in 1959. A committee

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comprised of teachers with ability both in the teaching of science and in writing, was commissioned to write new science textbooks following the guidelines established by the Central Commission of the Department of Education.

The 1959 science teaching curriculum was revised in 1967 according to the following objectives:

a) The curriculum should be at the level of primary school children;

b) The curriculum should be practical; this means that the days of science teaching by books alone are over;

c) The curriculum must be regional; the instruction must be based on the environment characteristic of each region.

In accordance with the curriculum now in force, textbooks which are succinctly but clearly conceived are written and produced to satisfy the particular needs of each school.

In general, the Department of National Education does not spend a great deal for the provision of science teaching materials at the first level.

Each teacher is required to manufacture the necessary items, using the resources of the region. The Instructional Materials Center studies the specimens sent by the teachers who initiate them with a view to their subsequent widespread diffusion whenever the Center thinks it appropriate.

Currently, thirteen provincial primary teaching services each have a very useful mobile scientific laboratory. The International Volunteer Service (IVS) is always ready to provide assistance to any of these thirteen laboratories.

Supervision in the primary schools does not present any particular problem.

Science teaching at the Second Level

Secondary education is divided into the first and second cycles. In the first cycle, natural science, mathematics, physics and chemistry are compulsory for all pupils. One or two hours of classwork per week are allocated to the teaching of each of these. There is no practical work.

In the second cycle (higher secondary), science constitutes an important part of the general syllabus and is divided into two distinct streams:

Stream A - experimental science;

Stream B - mathematical science.

Time allocations for science subjects in Higher Secondary Education : hours per week

Subject	Experimental Science	Mathematical Science
Natural science	2-4	1-2
Physics/chemistry	4-6	4-6
Mathematics	2	6-8

Of 230 secondary schools in rural regions, only 39 schools, or about 17%, have well-equipped laboratories. The teaching material prescribed in the curriculum is not available in the schools of these regions.

In 1968, results in the science streams of higher secondary education were as follows:

- 9,648 candidates admitted to the Baccalaureat 1st part, Experimental Science;
- 14,034 candidates admitted to the Baccalaureat 1st part, Mathematical Science;
- 4,944 candidates admitted to the Baccalaureat 2nd part, Experimental Science;
- 4,957 candidates admitted to the Baccalaureat 2nd part, Mathematical Science.

Teaching personnel. The teachers in the first cycle undergo a one-year course of teacher training in the Faculty of Education. Teachers in the second cycle must undergo four years of study in the Faculty of Education or the Faculty of Science (for a degree in science teaching). The total number of science teachers in the first cycle of secondary education is presently 245 with a diploma, and 774 without a diploma. In the second cycle, however, 520 science teachers have a diploma, and only 80 are without a diploma.

Curriculum and teaching materials. The science curriculum is drawn up by the Ministry of Education and Youth. Under this Ministry, the Instructional Materials Centre edits the science textbooks after they have been revised by technical and teaching consultants.

The supply of teaching and laboratory materials depends partly upon importation and partly upon foreign technical assistance. The estimated cost of installations of materials in schools of the second cycle for the year 1968 was US $53, 900.

The principal problems

The shortage of qualified teachers (as a result of the general mobilisation for war), the inadequacy of laboratories and scientific installations and the subservience of teaching methods to the exigencies of examinations are the greatest problems in science teaching.

A further handicap is that there is no body of supervisors or inspectors specialised in science, nor is there any arrangement for training such people.

The Present Programme for the Improvement of Science Teaching

First level

At the present time all primary schools follow the curriculum revised in 1967 which, it may be noted, has been slightly modified to meet immediate needs. In-service courses oriented particularly toward science teaching are held at the Centre for In-service Training in Saigon. As a result of this, all of the provincial primary teaching services have organized during the 1969 summer vacation an in-service course designed to help the teachers to provide a truly efficient teaching programme. There is not, however, a substantially new science teaching programme in operation in the country.

Second level

A recent decree of the Ministry of Education and Youth stipulates the formation of a committee on science and mathematics teaching for the second cycle. The objectives of this Committee are the following:

- To elaborate and propose a revised science teaching curriculum which is adapted to current progress in the world of science;
- Prepare science textbooks which will conform to the new curriculum;
- Organize in-service and pre-service workshops for science teachers and laboratory personnel;
- Maintain continuing liasòn with the SEAMEC Regional Centre for Education in Science and Mathematics in Penang, in order to be able to send teachers and students there to improve their knowledge, and to learn to make simple laboratory equipment with locally available raw materials.

SCIENCE EDUCATION IN WESTERN SAMOA

The national educational system of Western Samoa comprises three stages of school education: primary, lower secondary (intermediate), and secondary. There are 153 primary schools: 127 Government, and 26 administered by different religious missions. Of the more than 25,000 primary school population, some 80% attend Government schools while the remainder attend mission schools. There are over 6,000 pupils in 39 schools at the Intermediate stage. There are six schools at the secondary stage; three of these are government schools. (Figures refer to 1968).

The present status of science education

Primary school: In the first three grades of this level (Primers 1-3) science instruction is in the form of incidental environmental day-by-day studies depending of what the pupils may bring to school, or on what the teacher may plan for his class; e.g. "nature walks". One hour per week is allocated for this subject. At present, there is no Education Department programme for this level. In the upper grades of the primary schools (Standards 1-4), a weekly programme is published each term in the Department's publication "Tomatau". A list of topics to be covered each week is given together with teaching notes and lesson preparations. This is further supported by fortnightly broadcasts to schools whereby teachers are asked to prepare appropriate materials before the broadcast lesson.

Intermediate level: (Forms I and II) In conjunction with a current Unesco/UNICEF project in science education, provisional syllabuses in Basic Science for these grades were completed and

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This article is a condensation of a paper prepared by Mr. Tamalie Pine Matalavea, Headmaster, Falealili Junior High School, Poutasi, Western Samoa.

introduced into schools in 1967. These are detailed lesson-by-lesson schemes of work. Revision of these lessons continues as the project proceeds. Of the 25-hour weekly timetable in schools, $1\frac{1}{4}$ hours are allocated to Basic Science: one hour for the classroom lesson and fifteen minutes for radio broadcasts to support and extend concepts taught in the classrooms.

Junior High Schools: (Forms III and IV) Syllabus concepts in the form of 'outline schemes" were also completed in 1967, and are taught where Forms III and IV are attached to the Intermediate classes. Further revision and additional topics related to the Samoan environment are constantly in mind.

Secondary education: Science teaching at the second level is academic and taught mainly for examination purposes. At present, students of local secondary schools are prepared for the New Zealand School Certificate and University Entrance. A student may study either general science or select from physics, chemistry and biology as separate subjects. A majority of secondary schools offer optional science at Form IV, (Grade 10) when three periods (40 minutes each) are given for each discipline. Considerable improvement in the provision for the separate disciplines at a Form V level (New Zealand School Certificate) has come about following the supply of UNICEF equipment which arrived early in 1968.

Teaching personnel

There is an overall shortage of science teachers at all levels. In Government schools, the highest level of training is that of the Teachers Training College in Apia. At this College, General Science is an optional subject. A small number of students are now attempting New Zealand Certificate Biology.

So far as is known, there are no teachers in primary or intermediate school with special qualifications to teach science. In-service training between school terms of those teachers following the Unesco Science Syllabus has been in operation from late 1965. Such teachers pay the cost of attending in addition to giving up vacation time.

The one Government Teacher Training College in Western Samoa has offered since 1968 a three-year training to students who are due for posting as teaching staff.

Curriculum materials and laboratory equipment

Few or no science textbooks suitable for Samoan pupils are to be found in primary, intermediate or junior high schools. A number of recent Australian and New Zealand school texts for science would be partly suitable for Samoa, but there are insufficient funds for their purchase.

It is now intended to prepare a text for the use of pupils in Form I. The content will aim to draw to a maximum from the Samoan environment, and will correlate with the teaching syllabuses now in operation, taking into consideration the very limited experience of the pupils.

Only the secondary schools have special laboratory provision. Of these, seven possess minimally satisfactory laboratories. Most available laboratory equipment for intermediate and secondary schools has been procured through agreement with UNICEF. To provide for replacement of equipment now in use, items may be purchased directly by schools from a reserve store. A small workshop is also being developed for the construction of simple science apparatus for purchase by schools. The supply of equipment can only be sustained on a self-supporting basis. No items are manufactured locally as yet.

A small number of schools are now studying the possibility of building special science rooms. The Unesco adviser is at present assisting in recommending the adaptation of existing classrooms, for a low cost conversion.

The principal problems

Improvement in the standard of training in science at the Teacher Training College should carry a high priority. It is hoped that further assistance may be obtained in the later development of the Unesco/UNICEF project toward the improvement of teacher training.

A potential problem, now increasing, is relating manpower requirements to the supply of young people educated to particular levels. A more comprehensive approach to education is required. Science teaching in the junior high schools and for less academic streams in the secondary schools must also be planned to be relevant to the Samoan situation.

Regional and sub-regional science projects

THE UNESCO PROJECT FOR CHEMISTRY TEACHING IN ASIA

Bangkok, Thailand

The General Conference of Unesco, at its thirteenth session, adopted a resolution to organize a Pilot Project for Chemistry Teaching in Asia for the purpose of initiating a fundamental re-orientation in the way of teaching chemistry through the use of modern technical devices and methodology. An agreement was signed between the Government of Thailand and Unesco in 1965 to locate the project at Chulalongkorn University, Bangkok. The project started as a regional project, but since 1967 has become a national project with a regional character.

The primary aim of the Project is to assist science educators in their task of carrying out reforms in chemistry teaching. The Project is operating along two major lines which are distinct but coordinated: (1) Modernization of the chemistry courses and development of new teaching materials. (2) Assistance for in-service and pre-service teacher training, improvement of examinations, and textbooks, and use of the latest methods of teaching.

An International Working Group was formed at the Project during 1965/66. It consisted of chemistry teachers, scientists, and other consultants drawn from universities and teacher training colleges throughout Asia. The Group carried out basic research work into the actual chemistry content which is found in most school

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This article (here somewhat condensed) was prepared by Prof. J. Zyka, Director, Unesco Project for Chemistry Teaching in Asia, Bangkok.

courses. The participants also took part in writing programmed instructional sequences, developing suitable chemical systems for student instruction, making 8 mm. short film loops and mainly developing low-cost kits for experimenting at secondary school level.

This work is continuing, and Unesco is drawing to the Project at Bangkok recognized leaders of curriculum-reform projects from different parts of the world, in order to share their experiences in a first-hand way with the Asian science educators participating in the Project.

Unesco has invited science educators in each Asian country to organize a Study Group for Science Teaching Improvement, which can affiliate with the Project and receive support and help in its work. These Study Groups exist in Afghanistan, Burma, Ceylon, India, Indonesia, Iran, Israel, Japan, Republic of Korea, Nepal, Malaysia, Philippines, Pakistan, Republic of China, Singapore, and Thailand. Unesco is assisting these Study Groups in several ways: by supplying experimental teaching materials prepared by the International Working Group in Bangkok to stimulate local preparation of textbooks and other teaching materials; by arranging for representatives from outstanding curriculum reform projects to visit study groups as consultants for in-service courses for teachers, or as consultants on curriculum reform and the preparation of teaching materials; and by providing fellowships for members of National Study Groups to come for periods of 3-6 months to work with the International Study Group at the Project in Bangkok. (The Project's topics are now being extended to include Physics in 1969 and are expected to cover science in general in the coming years).

In inviting local study groups to affiliate with the Project for Chemistry Teaching in Asia, a major purpose is to help reduce the sense of isolation that many such groups experience. The reform of chemistry teaching in a particular country is not a once-for-all achievement; it is a continuous process of renewal, drawing inspiration from research in chemistry teaching which is taking place in many parts of the world.

The Project can supply study groups with resource materials, and act as a clearinghouse for information about the activities of these groups. In order to disseminate this information, a bi-monthly Newsletter is published at the Project in Bangkok and distributed in about 500 copies. In return, study groups are asked to send to the Project their comments on the resource materials supplied to them, and accounts of experiments which make use of these and other chemistry teaching materials; they are also asked to keep the Project informed of their activities.

Materials produced at the Project

1. Programmed instruction sequence, 1966;
2. Teachers' Guide to the above programmed sequence;
3. Film loops in cassettes (8 mm.);
4. Teachers' Guide to film loops and film loop production notes;
5. Compound formation (Vols. I and II), (teachers' digest);
6. Chemical equilibria, (teachers' digest);
7. Experiments on chemical equilibria;
8. Experiments on compound formation;
9. Compound formation Vol. I (Thai translation);
10. Experiments on chemical equilibria (Thai translation);
11. Newsletter, a bi-monthly periodical;
12. Prototypes of low-cost kits: "Teaching experiments on chemical equilibria", "Teaching experiments on compound formation" and "Teaching experiments on rate of chemical reactions".

THE SEAMEC REGIONAL CENTRE FOR EDUCATION IN SCIENCE AND MATHEMATICS

Penang, Malaysia

The South-East Asian Ministers of Education Council (SEAMEC) approved in principle a regional project for Education in Science and Mathematics, to be established in Penang, Malaysia, at its second conference held in Manila in November 1966. Following upon this, a Steering Committee, composed of two delegates from the six participating countries, namely, Indonesia, Malaysia, Philippines, Singapore, Thailand and Republic of Viet-Nam was formed and held its first meeting 1967.

With the assistance of a Task Force, made up of top level educators from the region, the Steering Committee tabled a Draft Development Plan, at the third conference of SEAMEC held in Singapore in February 1968. The Draft Development Plan was reviewed and revised in April 1968, and at its third meeting held in Manila in May 1968, the Steering Committee approved the Refined Development Plan for submission to SEAMEC and to the Government of Malaysia acting as the host country.

Objective and functions of the regional centre:

The objective of the Regional Centre is "to help the participating countries in improving the teaching of Science and Mathematics in the region in order to lay the foundations for meeting the technically and scientifically trained manpower requirements of the region. It is proposed to start initially at the elementary and secondary levels and to involve teacher training institutions and Colleges of Education, Faculties of Universities as may be necessary in implementing the programme".

This article is based on papers prepared by Mr. C. Ganasalingam, Programme Co-ordinator of the SEAMEC Regional Centre for Education in Science and Mathematics, Penang.

In proposing to concentrate initial efforts on the teaching of science and mathematics at the first and second levels, it is felt that very far-reaching effects on the social and economic development of this region can be achieved. The actual social and economic development of the region ultimately depends on the many who will not be educated beyond the secondary stage of education. This emphasis in improving science and mathematics education will, it is hoped, help to build up the educational base for industrial growth and technological change.

Care has consequently been taken to ensure that the Regional Centre will not be competitive in an adverse way with national institutions or programmes that are already in existence or operation. In order that the Regional Centre functions only to complement and supplement national programmes in member countries, the following guiding principles have been followed:

1. Only projects which are attainable through regional cooperation at a benefit rate higher than could be obtained by similar expenditure at national levels are to be organized.

2. Priority will be given to courses for key personnel from the various member countries, who on completion of the training received at the Regional Centre could be counted upon on their return to train thousands of teachers in their respective member countries on the latest developments in the teaching of science and mathematics.

3. The Regional Centre is to act as a catalyst in stimulating action and in disseminating the latest developments in respect of science and mathematics education in the region. Where a member country has taken the initiative in developing new programmes, the Regional Centre will plan to extend the benefits of such programmes to other member countries. In other words, the role and responsibilities of member countries are planned on a two-way-traffic basis and the main responsibility of the Regional Centre is to mobilize the best talents both within as well as outside the region for the furtherance and improvement of science and mathematics education in the region...

Organization and administration

The Centre will be administered by a Director under the overall policy direction of the Steering Committee composed of two delegates from each of the participating member countries. In order to bring together educators and scholars in the different fields of science and mathematics in the various member countries and to involve them and the professional organizations they represent in the programme of activities of the Centre, member countries have been requested to co-ordinate the activities and plans of national institutions through national co-ordinating committees and national science centres.

At the same time, the Regional Centre is to establish links with all international and regional organizations dealing with science and mathematics. It has also decided to set up an International Advisory Group made up of educators and scholars of international reput in science and mathematics to guide the Centre in developing its programme of activities.

Project building complex, staff and equipment

The project is operating for a period of two years from 1968-1970 with support services and facilities provided by the Malaysian Government at the Malayan Teachers College, Penang.

A permanent centre will be built in two phases. Phase One calls for construction of the first hostel for 60 persons, and a dining block serving as temporary administration offices and containing some classrooms. Phase Two plans for building of an Administration Building, and Information, Library and A.V.A. Centre, two teaching blocks, two more hostels for 60-120 persons, a laboratory block and some staff housing. An International House and some apartments will be built for staff members.

Staffing for the Centre will consist of the Centre Director, Deputy Centre Director, three heads of divisions, twenty professional officers, a Librarian, A.V.A. specialist, Information officer and Registrar and five consultants. There will be 18 professional officers from SEAMEC countries and 12 from Malaysia, in addition to five consultants.

The equipment and books will include office equipment, a car and van, equipment needed for printing, science laboratories, prototype apparatus, and a production workshop and A.V.A. unit in order to carry out training, research materials development and information programmes.

THE ASIAN ASSOCIATION FOR BIOLOGY EDUCATION (AABE)

Soon after early reports about the Biological Sciences Curriculum Study (BSCS) and Nuffield Biology projects were received in Asia, science educators turned to these projects for guidance in revising their own school biology courses which in some cases had existed unchanged since their introduction several years before World War II. By about 1962, a number of Asian countries had become involved in adaptation projects of one or more versions of the BSCS. Among the first countries to be so involved were Ceylon, India, Japan, Rep. of Korea, Philippines, Rep. of China and Thailand.

Dr. Arnold Grobman, then director of the BSCS and who had been in close touch with science educators and the scientists involved in school biology curriculum projects in these countries, suggested that a regional conference among biology educators whose curriculum improvement projects were in various stages of development would be helpful for the countries and others who might wish to start similar projects. Accordingly, a group of Ceylonese and Philippine scientists and educators met in Peradeniya, Ceylon, in 1965 and worked out the details for the first Asian regional conference on school biology which was subsequently be held in Manila, December 1966.

The delegates to this conference voted to found an organization named "Asian Regional Association for School Biology Education" (AABE), and elected an executive committee of five members, with Dr. L.B. Soriano of the Philippines as Director. The

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This article is a condensation of a paper prepared by Dr. Dolores F. Hernandez, Executive Secretary, AABE; Director, Science Education Centre, University of the Philippines.

delegates also moved unanimously to have the secretariat of this association housed temporarily in the Science Education Center of the University of the Philippines. The Executive Committee of AABE has held two conferences in Tokyo, in 1967 and 1968.

Activities of the organization have been mainly along the following directions: (1) dissemination of information regarding projects in biology education which authorities accept as outstanding and significant in the teaching of biology at the second level (e.g. BSCS and the Nuffield projects); this is accomplished in conferences at which exhibits include curriculum materials, teaching aids and equipment; (2) dissemination of information for biology teachers through the newsletters; (3) dissemination of information regarding trends in biology education to biology educators through discussions at conferences and publication of the proceedings; (4) encouragement given to delegates to implement "action" programmes aimed at improving biology education on the secondary levels in their countries. Most of these activities have been directed towards improvement of biology education rather than the stimulation of research. The second conference, however, did consider the subject of research through one of the leading papers.

The AABE is a young organization, with at present 35 founder members, 12 honorary members and three special members. The Association could easily settle down to a routine of holding biennial conferences, of publishing proceedings of such conferences and the quarterly newsletter of the association. These are the mechanics that help keep an organization alive. But to make AABE not only viable but a vital living organization, the content, the ideas of these activities need to be seriously thought out by its leaders and founder members. Co-ordinating the work of this organization with that of other agencies having similar objectives also needs to be studied and worked out so that common objectives could be more forcefully and more effectively implemented.

Science education outside the Asian region

In the following pages, information is given on some of the significant activities in science curriculum reform which are taking place in other parts of the world. This material has been abstracted from up-to-date information which was available in time to meet the publication date.

SOME SECONDARY SCIENCE CURRICULUM DEVELOPMENTS IN AUSTRALIA

Background

In primary schools in Australia, science education has classically been "nature study", in which students have been encouraged to "find out" about living things. In recent years, the subject has been broadened to include study of the whole non-human world, and been retitled "science". Although there has been some experimentation with process-orientated courses, there is a widespread view that primary science should be largely experience-oriented ; any significant development of abstract concepts should be left to secondary schooling.

Junior secondary science courses usually consist of four years of general science, with recommended syllabuses and a variety of available texts. In recent years, some attempt has been made to produce integrated science syllabuses and integrated textbooks to accompany them. Junior science is a core subject for nearly all students.

At senior secondary level, separate sciences are usually offered, as options: these include physics, chemistry, biology, agriculture, and geology. Each is available as a two-year course which can be taken concurrently with general subjects, with other sciences and/or with mathematics.

This article is a condensation of an address given at the Pacific Science Intercongress, Kuala Lumpur, in May, 1969, by Mr. D. G. Morgan, Head of the Biology Department at the Secondary Teachers' College, Melbourne, Australia.

Secondary science courses in Australia have been like those in many other parts of the world. A syllabus was set down which indicated the information to be presented - and examined - and the skills to be acquired. Practical work was usually to illustrate the 'truth' of points the teacher had made. The student's task was to present a beautifully set-out practical book and to recall, at the examination, material presented to him earlier by the teacher. The content was far behind contemporary science.

The Junior Secondary Science Project

In recent years, there has been an attempt to emphasize *science as enquiry*, and to achieve behavioural goals in science education. "Discovery" methods have been used in a number of recent junior science books. And, in 1966, the Junior Secondary Science Project (JSSP) was set up to develop teaching materials for the first four years of secondary school science. The course has been constructed as a series of units, published on numbered cards, and supplied to classes as a box of materials for each unit. The cards set out individual work programmes which students follow in sequence at their own rates, under the guidance of the teacher. All the students perform a basic sequence of learning activities in each unit; enrichment activities are provided for faster-working students, laboratory and field experiences as well as testing are built into the programme. A Teacher's Guide accompanies each unit.

The JSSP materials are designed to assist the individual student, conveying to him something of the nature of science. Though the materials have proven to be most effective in the hands of the most capable teachers, they provide also a good basic classroom programme for the less capable or less qualified teacher. Materials for Grades IX and X are still being developed.1/

Senior science courses

At senior secondary level, curricula developed overseas have had some impact in recent years; two U.S.A. courses - CHEM Study and PSSC - are being widely used.

In biology, a curriculum project has led to a new biology course designed for the last two years of secondary school and now in very wide use in Australia. Although this course was developed from materials developed in the U.S.A. by the Biological

Sciences Curriculum Study, (BSCS), the course itself differs quite widely from any of the original American courses.

The BSCS "Australia Version": From 1960, the BSCS prepared three alternative biology programmes for grade X in U.S. schools and, subsequently, a special materials course for slow learners, and a second level course for grade XII. A selected group of teachers in Australia conducted classes with the various U.S. versions.

It soon became apparent that the real strength of the BSCS courses lay in their approach rather than in their content. In trying to convey science as enquiry the courses were much more student-centred in their methods than were traditional courses; they could not only change a student's knowledge but his ways of thinking and his attitudes as well.

From the experience gained, however, it was decided that if U.S. materials were to be used they would have to be altered to operate as a two-year course (grades XI and XII), would need to be based on Australian organisms, and would need to incorporate other changes to make them more effective. The official "syllabuses" and public examinations would also have to be altered accordingly. Finally, it was decided to produce not three versions, but a single version that had no particular content emphasis.

The Task: Since no student can study everything in science, we must choose a small part which can exemplify the scientific process in general. A two-year biology course was chosen. It was decided to try and cover the whole field of biology in the two years, thus providing a "third level" at which biology is considered by the student, beginning with primary. In the senior years the student can bring new abilities and understanding to play and see relationships he could not when he was younger.

Older syllabuses used to list specific content to be covered. It was decided instead that more emphasis should be given to developing broad understanding by the student than to asking him to recall a selected set of information. So a list of some major generalizations of the biological sciences was agreed upon. These were to form the basic "content" of the course. In order to ensure that an appropriate impact was made on the student it was agreed that in the classroom development of each idea -

1. students be given either direct personal experience of living organisms or the next best substitute (films, slides, or a

well-illustrated, interestingly-written piece of reading) if they have not had the necessary experience before;

2. a learning situation be set up in which a student would have a chance to develop concepts for himself - through set problem-solving activities, by discussing ideas with his colleagues in the classroom, and so on. The student should be in the centre, not the teacher;

3. a student be given practice in applying his ideas to new and everyday situations until new ideas and new ways of thinking became a part of him; and

4. a student be given practice in communicating his ideas to others, both orally and in writing.

Methods and materials: One of the facts of the Australian situation is that the teacher has only very limited time to prepare really effective learning situations. His task is much easier if he has available teaching materials which can be modified as necessary to suit his own teaching situation. The course designers therefore set about developing a set of curriculum materials which would be used to achieve course objectives. Each of the generalizations was split up into a series of single concepts, an appropriate learning situation was conceived for each, and materials were written. The materials were arranged in workable sequences and published in an outline form suitable for easy teacher reference. The materials 2/ were arranged as two laboratory manuals (one for each year of the course), a text, a teacher's guide, and some supplementary materials. Problems were set for discussion in classroom groups to help concept development and communication and help make ideas a part of the student's thinking.

Teacher preparation programmes were conducted by the course designers themselves, aimed toward getting the teacher to a point where he saw himself in a new role in the classroom and could organize class activities in a new way. No attempt was made in such courses to convey up-to-date biological knowledge; this was incorporated in the materials themselves.

Many people devoted time and effort to the project for little or no reward, or were paid by their employers to assist; no royalties are paid to writers. The Australian Academy of Science arranged the printing and distributed directly to schools: cost of the material to the student was in this way kept to less than half of that of similarly-printed commercially distributed materials.

Examinations: Tests developed for the BSCS in the United States proved far too elementary for the Australian student of grades XI and XII, and they did not test all the objectives of the Australian course. A taxonomy of the educational objectives sought in the Australian course was developed, partly from other taxonomies, and weightings given to the various classifications. Process and content goals were weighted appropriately, and different types of questions developed to suit the various course objectives. The responses of students to public examination papers have been computer-analyzed for item validity and reliability, and the results published and made available to teachers.

In addition, the Australian Council for Educational Research has assembled panels of teachers, biologists and specialists in educational measurement to develop readiness materials, and diagnostic and achievement tests that teachers can use in the classroom. These are now becoming available. It has been our experience, interestingly enough, that the development of appropriate tests to measure the goals of this course is a very difficult task, beyond the capacities of many who conduct the course in the classroom or attempt to examine similar goals at the universities.

Further development of materials: From the time the course was first introduced, in 1967, continuous contact has been maintained with class teachers to follow the progress of students and teachers in the classroom. It is intended that a complete new edition of the materials - in which the biology content is up-dated and the teaching approach improved - be published for 1972, five years from the date of publication of the first edition.

Despite the continuing need for improvement in the published materials, it is clear that many of the objectives set originally are being achieved. The course is also proving popular: the Australian BSCS - an optional course - is now taken by a high proportion of all the senior secondary school students in five Australian States.

It has been our experience that programmes of this nature cannot be brought to fruition simply by decisions of a committee or of some person in authority. The success of a task depends first on defining the task, then on really hard work by a few key people who must have assistance from research scientists and access to all levels of the educational system. They must also have the necessary abilities; it seems that there are relatively few people who combine all the talents needed for a task of this nature. Success also depends on appropriate changes being made in every part of the educational system concerned: in the equipment of schools, in publication of courses of study, in examinations, in teacher training, and so on. This means active co-operation and co-ordinated efforts of everyone involved.

Our experience has shown that up-to-date and effective science teaching materials can be prepared by a handful of suitably-qualified people, given the right advice, at much less cost and much more readily than one can update the scientific knowledge of every individual science teacher in the country.

References

1/ Details of JSSP materials may be obtained by writing to the Director, Junior Secondary Science Project, Australian Council for Educational Research, Frederick Street, Hawthorn, Vic. 3122, Australia.

2/ Published as "Biological Science: the Web of Life" - Text, Student's Manual Part I, Student's Manual Part 2, and Teacher's Guide. Available from the Australian Academy of Science, Gordon Street, Canberra City, A.C.T. 2601, Australia.

Note: This article describes some of the most recent developments in Australia. For a description of the "Science for High School Students", a textbook series for a six-year integrated science course, the Summer Science Schools and the work in science education of the Nuclear Research Foundation in the University of Sydney, see New Trends in Physics Teaching, Vol. I (1965-66) Unesco, Paris, pp. 70-78. Summer Schools in Chemistry have been held at the University of New South Wales since 1961, and are described in the "Approach to Chemistry" series, published by the University of New South Wales, Sydney.

THE NUFFIELD FOUNDATION
SCIENCE TEACHING PROJECT

Background

Before the Second World War science did not occupy the leading position in schools in the United Kingdom it now does, and science masters had to fight hard to improve the position of their subject. Curriculum development was not organized, and such developments as there were came either from the Inspectorate of the Ministry of Education or from the Science Masters Association, which was a voluntary organization of science teachers, most of them in selective secondary schools.

After the war, when the present position of science in schools was recognized, the Science Masters Association made a policy statement declaring that all pupils in secondary schools should do a full course of science consisting of physics, chemistry and biology. To this end they prepared model syllabuses in these subjects, pruning away irrelevant matter and introducing considerable new work. The range of these syllabuses was for pupils aged 11-16 years, at the end of which time these pupils might be expected to sit for one of the Ordinary Level Examinations of the ten separate University Examining Boards.

The start of the Nuffield Project

The Syllabus Committees of the Science Masters Association - now the Association for Science Education (ASE) - began to realise that this was more than just 'syllabus revision' - it was curriculum development with all sorts of ramifications, including the writing of books for teachers and pupils, the production of new examinations and the tremendous task of teacher re-training. It

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This article (here somewhat condensed) was written by Mr. L. Ennever, Director, Nuffield Science 5/13 Project, and Dr. G. Van Praagh, Member of the Centre for Curriculum Renewal and Educational Development Overseas, London, W.C. 1.

was at this point in April 1962, that the Nuffield Foundation offered help in the form of money to be spent on (a) releasing members of the ASE Syllabus Committees, and others, from their teaching posts and providing substitute teachers, (b) providing office accommodation and secretarial facilities, (c) enabling many schools to take part in development trials, and (d) paying for conferences and working parties.

Headquarters teams were set up consisting of A.S.E. syllabus committee members, helped by Consultative Committees, of University Professors and experienced teachers. The courses were developed in collaboration with about 200 schools, from whose 'feed-back' the drafts were modified and re-written several times. The product is the Nuffield Ordinary ('O') Level Science, five-year courses in Biology, Chemistry and Physics for 11-16 year-old children in Grammar Independent Schools. The Teachers' Guides and Pupils' Books number about 70 in all, in addition to which about 60 film loops were produced.

It was soon realised that these 'O' level courses would be better rooted in fertile experience gained by pupils in primary schools, so the Nuffield Junior Science Project was then set up. Furthermore, many grammar schools requested a simple course in science for the first two years, i.e. for 11-13 year-olds. This gave rise to the Nuffield Combined Sciences course in which the first two years of the 'O' level courses were adjusted to make a single course.

There followed the Advanced Level projects for pupils in the Sixth Forms of Grammar schools, whose ages are roughly from 16 to 18 years. These four separate projects were in physics, chemistry, biology and in addition, a project was undertaken that explored the area common to physics and chemistry: this was the physical sciences project.

The 'O' Level Projects were devised for the top 20-25% of the intelligence range, for this is the group served by the 'O' Level Examination. What about the remaining 75-80% of secondary school children?

Six of Her Majesty's Inspectors of Schools made a preparatory study which formed the basis of another Nuffield Project: Science for Secondary Schools. This is designed for pupils of average ability aged 13-16 years and is based on the study of eight broad science themes. It will provide materials for both teachers and pupils and will suggest a number of sample routes through the materials, so that suitable courses may be constructed to suit a variety of situations.

List of the ten Nuffield Projects

1.	Ordinary level Physics*	(ages 11-16)
2.	" " Chemistry*	(" ")
3.	" " Biology*	(" ")
4.	Combined Sciences**	(ages 11-13)
5.	Junior Science*	(" 5-13)
6.	Science in Secondary Schools***	(" 13-16)
7.	Advanced level Physics***	(" 16-18)
8.	" " Chemistry**	(" ")
9.	" " Biology**	(" ")
10.	" " Physical Sciences**	(" ")

* Completed
** To be published in 1969-70
*** To be published in 1970-71

The nature of the projects

These projects are all devoted to "teaching for understanding"; mere memorization and recall of factual material is reduced to a minimum. Their broad aims were to encourage enquiry by the pupils themselves, to help them become aware of problems in the field of science and to encourage them to find the answers themselves, principally through practical investigations.

The materials produced are varied in form; all projects produce teachers' guides, and some produce course books for pupils. There are guides to practical work and, for some projects, background books. As would be expected, a good deal of attention was given to apparatus, and new pieces of apparatus were designed for many projects. The storage of apparatus, for physics in particular, and laboratory organization were studied in some detail.

It was realized from the start that such material as this, that demanded and encouraged pupils to think for themselves rather than to recall what they had read or been told, could not be tested by traditional examination questions. Questions of a new form would be needed and the collaboration of the Examining

Boards in developing suitable questions and providing suitable examinations was obtained early on in the Project.

The Department of Education and Science and the Schools Council have been active in providing courses for teachers. One result, arising from trials of the Junior Science Project, has been the setting up by local authorities throughout the country of Teachers' Centres - there are about 250 of them now - where primary school teachers could meet to reinforce their work in science and mathematics. Many of these Teachers' Centres are broadening their original basis and extending their work to other areas of primary and secondary school work. A further important development is the opening of the Centre for Science Education at Chelsea College, University of London.

It is well recognized by teachers and administrators alike that they owe the Nuffield Foundation a debt of gratitude for the work it has initiated and inspired. There is on the other hand no inclination to sit back and be satisfied with the courses already devised. They are a starting-point rather than an end-point, and the Centre for Science Education will be staffed and equipped to enable School Science Education to be kept continually under review. Full-time research staff will work in close co-operation with practicing teachers and local schools in order to effect this.

In conclusion let it be said that courses developed in one country for its own teachers, pupils and school circumstances, will not necessarily transplant to other countries satisfactorily. While we believe that the Nuffield courses will be of great assistance to developing countries in redesigning their school science, we feel strongly that the Courses should not be adopted as they stand but adapted to suit the local conditions. In order to assist developing countries in this respect, the Nuffield Foundation, in collaboration with the Ministry of Overseas Development and the British Council, have set up a small organisation called CREDO (Centre for Curriculum Renewal and Educational Development Overseas). General science projects are already in progress, notably in East Africa and Malaysia, and many others are about to begin. (See: Modern Curriculum Developments in Britain, published in 1968 by CREDO, Tavistock Square, London, W.C. 1, and the Science Education Newsletter, issued by the Science Department, The British Council, 59, New Oxford Street, London, W.C. 1).

SCIENCE EDUCATION IN SCOTLAND

New syllabuses in physics and chemistry were introduced in Scotland in 1962 after a very short period of trial in a few schools in the previous year. They are contained in the Scottish Education Department Circulars 490 and 512. A Memorandum was issued by the Department in 1962, strongly recommending that in the general course of the first two years, biology should be given parity of treatment with physics and chemistry, and suggesting a syllabus which offered a marked contrast to the restricted traditional topics.

It may be thought to have been very foolhardy to introduce new schemes to schools without adequate testing, especially when it is remembered that the Nuffield schemes were submitted to very extensive (and expensive) trials before they were made public. It was felt, however, that the need for revision was so urgent that the offer of new syllabuses to the schools could not be postponed until they had been perfected. What, in fact, happened was that the Scottish Education Department offered the syllabuses in physics and chemistry to the schools as alternative to the traditional ones for the Scottish Certificate of Education at Ordinary and Higher grades. The schools were therefore assured that, if they adopted the new syllabuses, an examination would be available for them; implicit in this was the guarantee that their pupils would not suffer. Scotland thus became one large pilot area, as many schools as wished joining in. It was made clear that there might be some amendments to the syllabuses in the light of experience, but so far these have been comparatively minor.

The response to the new proposals was immediate. One-third of the pupils taking Scottish O-grade physics and chemistry took the new papers in the 1966 examination, which means that

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This material has been abstracted from an article by A.J. Mee, W.R. Ritchie and S.T.S. Skillen in The School Science Review. (The Journal of the Association for Science Education, U.K., Vol. 48, June 1967, No. 166, pp. 685-691). With permission.

this proportion of schools started on the schemes as soon as they were published. The last examination on the traditional syllabus will be held in 1971.

The fact that so many schools have adopted the new syllabuses in physics and chemistry does not necessarily mean that they are successful. So far, of course, experience is rather limited, but some teachers have questioned whether the schemes are suitable for other than the really able pupils, and will therefore discourage many from taking science, and others wonder whether they are equally suitable for girls as for boys. Only partial answers can be given to these questions at present. Because of their demand on reasoning and the devising of experiments to meet situations which the pupils have not necessarily encountered before, the examinations will be more difficult for those who previously were able to pass merely by learning facts by heart. It may well be that some will pass now who would have failed before and vice versa, but there can be no doubt that those who are successful will have a greater understanding of science than those taught on traditional lines. Some schools have reported a decrease in the number opting to take science, while others have found a large increase. It has been found that pupils in many of our 'four-year' schools (which provide 3-and 4-year secondary level courses for students up to 16 years of age) have been quite successful with the new courses, so it appears that the fear that the schemes would suit only the most able pupils is likely to be groundless. With regard to their suitability for girls the evidence is rather mixed, but it is a fact that in some schools the proportion of girls opting to take science has increased, while in other it has fallen. Much obviously depends on the methods of presentation and on the other subjects with which science has to compete.

It is difficult to convince a body of teachers that their methods are not wholly satisfactory, and it is not surprising that not all have really grasped the aims that the schemes hope to foster. There are still some who teach the new syllabuses with a traditional slant, some who are suspicious that unless facts are drilled home the pupils will learn nothing, some who say that there is little that is tangible upon which to base further study, and some who think that looseness of expression is being encouraged at the expense of accuracy in the statement of definitions and laws. These fears and suspicions are, in fact, groundless, at those who have taught the complete course have discovered.

When the schemes were first launched teachers found it very difficult to leave familiar topics, such as density, expansion and contraction, the separation of liquids by distillation, and the earthworm, without the traditionally detailed treatment. This over-detailed work has meant that the pupils' progress in the early stages was not as rapid as was expected, but teachers who are now on their second or third time through the first year have speeded up considerably as they have begun to see how the new themes develop. Not surprisingly, it is sometimes only when the final year has been taught that this perspective has been gained and teachers have appreciated what trivialities can be played down in the earlier parts of the course.

A difficulty with which we have had to contend because of the way in which the courses were introduced was the lack, initially, of suitable apparatus. The manufacturers have helped considerably, and indeed one national advantage has arisen from the situation, viz., that the manufacturers have been able to 'tool up' for the larger Nuffield scheme which often utilizes the same equipment. In the course of this work many interesting new items of equipment have been developed, including a 'frictionless' puck made from a ring magnet, a cheap linear air track, a simple conductivity apparatus for chemistry, and a simple gas analysis technique for biology.

A factor which has handicapped some schools is the out-of-date design of the school buildings. In visiting schools one of our important tasks has been to search for suitable spaces in which to provide a science workshop and an apparatus store. A recent Scottish Education Department Building Note has ensured that in future these needs will be met - but older schools are sometimes difficult to modify.

Some of the individual topics, in the teaching of which worthwhile progress has been made, are the concept of bonding in chemistry and the applications of simple electrochemistry to the study of reactions. At the upper grades the study of the mechanism and energetics of chemical reactions is proving capable of reasonably simple treatment. This has direct influence on the teaching of plant and animal physiology. In physics, the new approach to dynamics which was developed largely by Scottish teachers working both for our own scheme and for the Nuffield syllabus has raised much interest among pupils and has revolutionized the teaching of this branch of physics. The concept of energy and its various manifestations and interconversions has also gone across well. The use of M.K.S. (S.I.) units has greatly helped in the unification of physics. Using the joule (newton metre) first of all in mechanics, then as a heat unit, and then in electricity where the volt is defined as a joule/coulomb, provides an educational approach of great power. Although in chemistry the kilocalorie is still used as an energy unit, it is likely that this will eventually be dropped in favour of the joule, thus carrying the unification even further.

New techniques are encouraging individual practical work in physiology and embryology and considerable effort is being devoted to the improvement of present methods of teaching genetics. Pupils engaged on fieldwork may be following some of the simple techniques given in the Department's booklet, "Fieldwork in Biology for Secondary Schools" (1963, revised 1966).

There has also been an attempt to co-ordinate science with mathematics to a greater extent than formerly. The new mathematics syllabus in Scotland is written from the outset with the intention of dovetailing with the science syllabuses. This very important exercise has probably not been carried out on a national scale previously - but it seems obvious that work on graphs, vectors, variation, statistics, errors, logarithms, and slide rules should be timed to help pupils in their science course.

One of the most valuable outcomes of the introduction of the new schemes has been the establishment of the Scottish Schools Science Equipment Research Centre (SSSERC) in Edinburgh. It has provided a regular series of bulletins for the schools, with suggestions for apparatus which can be constructed by school laboratory technicians and lists of suitable equipment for purchase. There is also a display laboratory where apparatus can be tried out by teachers, and the Centre has a van for taking new equipment to the more remote parts of the country. Local centres serving a complementary purpose have been set up by some education authorities for their own teachers.

We are not yet satisfied that we have the right kind of examination to assess the pupils or that teachers are fully aware of the difference between the requirements of the traditional and the new examination. Two Memoranda on Testing, which should help teachers to know what is wanted, have been issued.

CURRICULUM RESEARCH IN SCIENCE IN THE UNITED STATES

Developing and testing new school science programmes has been an activity of hundreds of university scientists and school teachers during the past ten years. These high-school curriculum projects did several important things. First, they stripped away the authoritarian discussions of modern technological advances which had been tacked on to science courses that were twenty years or more out-of-date. Second, they adopted the philosophy that teaching science was much more than teaching a catalogue of facts, and should be teaching facts together with concepts, and encouraging at the same time an understanding of and an ability to engage actively in the scientific enterprise.

To accomplish these things, the approach to teaching was radically changed. The Physical Science Study Committee (PSSC) led off the revolution in 1956. This group decided to deal with physics as a unified story in which the successive topics would lead toward an atomic picture of matter, and along with all this they hoped to develop the idea that physics is not a book completed or closed but is an unfinished and continuing activity. They designed new and simple laboratory equipment and devised new experiments so that the PSSC laboratory became the place where students carried on investigations, not simply demonstrations.

This article is a condensation of a report by Dr. Arthur H. Livermore of the American Association for the Advancement of Science, Washington, D.C. The article was first published in Research and Development Toward the Improvement of Education under contract between the United States Office of Health, Education and Welfare and the University of Wisconsin Research and Development Center for Cognitive Learning, Herbert J. Klausmeier, Director. With permission, it is reproduced here as condensed from The Journal of Experimental Education, Vol. 37, 1, (Fall 1968). Madison, Wisconsin: DEMBAR Publications Inc., pp. 49-55.

The Chemical Bond Approach (CBA) project grew out of a conference of college scientists and high-school teachers in 1957. The CBA group decided to make the most fundamental of all chemical concepts the central theme of the programme. Hence, the idea of chemical bonds has become the unifying thread of the curriculum. Chemistry is presented as an interplay of experiment and ideas: in the laboratory programme the students carry out small investigations, and in the classroom they learn to apply chemical concepts to explain their observations.

The Chemical Education Materials Study (CHEM Study) also stresses observation and concepts. The philosophy of the CHEM Study group is that the important concepts and generalizations of chemistry should be developed inductively and that the evidence that the students use should be gathered by them in the laboratory wherever possible. There is emphasis on the unifying concepts in chemistry rather than on great volumes and varieties of technical applications.

The Biological Sciences Curriculum Study (BSCS) of the American Institute of Biological Sciences faced some problems that were more touchy than those faced by the physicists and chemists. Traditionally, the topics of evolution and human reproduction have been taboo in high-school biology courses. The BSCS group felt that modern biology could not be taught without introducing these topics, and therefore included them in the three courses which they developed. There is now general acceptance of the new courses by schools throughout the country: about 80 per cent of all students taking biology in grade X are in one of the BSCS courses. Although the three BSCS programmes take different approaches to the teaching of biology, the goals are the same - to present biology as a dynamic and growing field of knowledge. A major accomplishment of the BSCS group has been to change the high-school biology laboratory from a place where dead, preserved specimens are dissected to a place where living organisms are examined and experimented with.

In every case, the curriculum groups prepared batteries of tests to determine whether high-school students could, indeed, learn science in these new ways. The results have been gratifying. One of the important accomplishments of all of the curriculum groups has been to bring together scientists and teachers to work out the new programmes. These are not courses handed to the schools by college professors, but are truly programmes that have been developed co-operatively.

Physics has never been a popular subject for high-school students, and the introduction of PSSC physics has not stimulated more students to study this discipline. There has been concern among scientists and educators that college-bound students, in general, should have some experience in this field. One group having this concern is developing a new high-school programme which, it is hoped, will encourage non-science majors to take physics. The programme, called Harvard Project Physics, adopts a cultural approach. It develops important concepts such as force, energy, and motion, but draws heavily on the humanistic background of the science.

The immediate short-range goals of the completed high-school curriculum projects seem to have been reached in a satisfactory manner. There are some areas, however, where further research remains to be done. All of the curriculum groups either explicitly or implicitly suggest that their approaches should develop in students an understanding of, and an ability to engage in, the scientific enterprise, and an interest in and enthusiasm for science which should carry on beyond the high-school years. Little has been done to determine whether the programmes do indeed have this effect. A long-range study to evaluate this aspect of the new curriculum programmes would be desirable.

Many of the scientists who worked on the high-school curricula are now devoting their energies, in collaboration with school teachers, to designing and testing science curricula for the early grades. The approaches that the various curriculum development groups are taking to achieve this goal vary widely. The Elementary Science Study of the Educational Development Centre takes the position that the child should be introduced to science by presenting him with a variety of materials to investigate. They have developed, and tested in classrooms, units on butterflies, gases and airs, kitchen physics, microgardening, meal worms, and many other topics. The School Science Curriculum Project of the University of Illinois has a philosophy similar to that of ESS.

The Science Curriculum Inprovement Study at the University of California takes a different approach. Its main thrust is to develop an understanding of science concepts starting in kindergarten with the simple concept of "What is an object?" and moving from there to "What is a system?", "What is meant by interaction?", and so on. Their programme is more structured than ESS but still leaves room for investigation by children.

A science programme for the early grades is the Minnesota School Mathematics and Science group, abbreviated "Minnemast". This group began by developing a mathematics programme and then devising science units to go along with it. Their science programme aims at developing both skills and concepts. So far they have seven units for kindergarten and first grade.

The project on which I am working is developing a programme called Science - A Process Approach, for K through grade VI. This curriculum development is one of the activities of the American Association for the Advancement of Science (AAAS) Commission of Science Education. A basic premise of this project is that a scientist's behaviour as he engages in his pursuit constitutes a complex set of skills and intellectual activities which can be analyzed into simpler activities. It is these simpler activities that we are calling the processes of science. Another premise is that the individual's ability to use these various processes can be developed in a step-wise fashion beginning in the earliest years of school. The processes for the early grades have been identified as observing, classifying, measuring, communicating, inferring, predicting, recognizing and using space/time relationships, and recognizing and using number relationships. For each of the processes there is a series of exercises of increasing complexity and difficulty which require the child to engage in activities in the classroom rather than to simply read or be told about science.

Junior high school (lower secondary level)

At the moment there are four groups who have developed curriculum materials for junior high school and tested them on a fairly wide scale. Then there are several other groups who are at earlier stages of curriculum development. The four programmes that are farthest along are centred mainly in the physical and earth sciences and astronomy.

The astronomy programme, known as the University of Illinois Elementary School Science Project, actually is designed for the later primary grades and the early secondary grades. This programme is frankly subject-matter-oriented and consists of a series of children's books and teachers' guides.

The second programme, which includes some astronomy but many other topics as well, is the Earth Science Curriculum Project; it is designed for grade IX. The course, called investigating the Earth, is an experience-centred course in which inquiry in the study of natural phenomena is stressed.

A third programme - Time, Space and Matter - is being developed by the Secondary School Science Project at Princeton University. This programme begins and ends in geology but includes a good deal of fundamental physical science as well. The students investigate topics such as solution, crystallization, and water erosion using well-designed equipment which is furnished to them in the form of individual kits.

A fourth programme, named Introductory Physical Science, is being developed by the same group that produced the high-school PSSC physics course. This course also is intended for grade IX and is designed to develop in the students basic attitudes and skills that they will need when they later encounter the new high-school programmes in physics, chemistry, and biology. The first part of the course considers matter and its properties and leads to the need to assume that matter is particulate in nature. The last part of the course considers the size of molecules, molecular motion, and energy. This course is laboratory-centred, and the group has devised simple equipment which permits students to carry on significant experiments in ordinary classrooms.

It is clear as one looks at the new developments in science curricula for the junior high school that we are a long way from a smooth-flowing science curriculum for these grades. There has been little or no co-ordination among the present curriculum development projects. As a first step toward co-ordination, the AAAS Commission on Science called a conference of representatives of the junior-high-school curriculum projects in science and mathematics, in 1965. As the representatives of the projects reported on their work it became clear that there was a major gap in the curriculum developments: no group was working in the field of biology. The Biological Sciences Curriculum Study has, for some time, been planning to develop a biology programme for junior high schools, but they have made no progress since funds have not been made available to them.

Review of the problems

As elementary science education moves from fairly passive learning through books and exposition to student manipulation and investigation, there will be an increasing need to provide supplies and equipment for the classrooms even as early as kindergarten. The amount of money provided for science supplies in most school systems is small, and will have to be increased manyfold to accommodate the new programmes. To assist school systems in planning for the introduction of the new elementary science programmes, the AAAS Commission on Science Education has been making a study of the costs of equipment and supplies.

Classroom design will also be influenced by the new science curricula. I think that, in the future, junior-high-school classrooms will need to be provided with laboratory space similar to that found in senior high schools.

A crucial problem raised by the new curricula is teacher training. Up to now, during the experimental stage the various curriculum groups have carried on this orientation and training on an ad hoc basis. In the future, as the programmes are more widely used, school systems must establish in-service training programmes.

Regarding the pre-service training of teachers, only one of the curriculum groups, "Minnemast", is preparing university material to train prospective teachers to use their materials. There is a group at Rensselaer Polytechnic Institute that is designing a new course in physical science for non-science majors with the thought that this course will better prepare new teachers to use the new school science curricula.

As the curriculum groups organized and developed their programmes, scientists and teachers collaborated, producing significant changes in science curricula, which could not have been effected by either group alone. Science curriculum research is a continuing activity, and the best minds in science and the best minds in education must be devoted to it.

References

Listed below are addresses of several of the curriculum development projects referred-to in this article. Those not appearing here have been listed on page 65.

AAAS	Science - A Process Approach Commission on Science Education, 1515 Massachusetts Avenue, N.W., Washington D.C.
CBA	Chemical Bond Approach Project Dr. Laurence E. Strong, Earlham College, Richmond, Indiana 47375.
ESSP	Elementary School Science Project University of Illinois, 805 West Pennsylvania Avenue, Urbana, Illinois 61801.
HPP	Harvard Project Physics Harvard University, Cambridge, Massachusetts 02138
Minnemast	Minnesota School Mathematics 720 Washington Avenue, S.E., Minneapolis, Minnesota 55414.
SSCP	School Science Curriculum Project 1102 West Main Street, University of Illinois, Urbana, Illinois 61801.
SSSP	Secondary School Science Project Rutgers-The State University, New Brunswick, New Jersey 08903.

BULLETIN OF THE UNESCO REGIONAL OFFICE
FOR EDUCATION IN ASIA

SCIENCE EDUCATION IN THE ASIAN REGION

SUPPLEMENT

International and regional conferences and meetings relating to science education

Research studies in Asia on science education

Notes on Asian documents on education

OECD and Unesco publications

Tentative calendar

UNESCO
Bangkok, 1969

INTERNATIONAL AND REGIONAL CONFERENCES AND MEETINGS RELATING TO SCIENCE EDUCATION

CONFERENCES ET REUNIONS INTERNATIONALES ET REGIONALES SUR L'ENSEIGNEMENT DES SCIENCES

A Bibliographical List* / Bibliographie*

1960

Meeting of Experts on the Teaching of Science in Tropical Africa, Abidjan (Ivory Coast) December 1960. *Science teaching in the secondary schools in tropical Africa* /a report of the meeting/ by J. Cessac. Paris, Unesco, 1963. 79 p.

To enable the States and Territories of Tropical Africa to man their economic, social and political development programmes necessitated by the achievement of independence and the demands for economic development, Unesco organized this meeting to study the science education needs particularly for the second level of education, a source of manpower for the multitude of posts. The experts analysed teaching materials and facilities, time-tables, supply of teachers, and the popularization of science. Although the suggestions and conclusions were considered in terms of Africa's needs, it was pointed out that they are applicable to other parts of the world.

Réunion d'experts sur l'enseignement des sciences en Afrique tropicale, Abidjan (Côte-d'Ivoire) décembre 1960. *L'enseignement des sciences en Afrique tropicale* /rapport/ par J. Cessac. Paris, Unesco, 1963. 87 p.

Organisée par l'Unesco en vue d'aider les Etats et territoires de l'Afrique tropicale à former les hommes nécessaires à l'exécution des plans de développement économique, social et politique rendus nécessaires par l'accession à l'indépendence, cette Réunion a permis d'étudier la situation et les besoins de l'enseignement des sciences, surtout dans le second degré qui prépare des jeunes pour une multitude d'emplois. Les experts ont examiné les sujets suivants: laboratoires et matériel scientifique, horaires, formation des professeurs de sciences, et vulgarisation scientifique. Bien que leurs suggestions et recommandations visent principalement l'Afrique, elles peuvent, ont-ils signalé, être appliquées dans d'autres régions du monde.

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* Meetings are listed chronologically. Titles cited represent documents available at the Unesco Regional Office.

* La liste des conférences et réunions suit l'ordre chronologique. La bibliographie ne mentionne que les documents disponibles au Bureau régional de l'Unesco.

1960 (Cont'd) / (Suite)

The OEEC Seminar on the Status and Development of the Teaching of School Chemistry, Greystones (Ireland) 29th February to 10th March 1960. *New thinking in school chemistry, report on the OEEC Seminar.* Paris, OECD, 1961. 251 p.

"The primary aim of the Seminar was to come to conclusions concerning the specific steps required to provide the basis for a curriculum better fitted, intellectually and practically, to the needs of modern chemistry".

Session d'étude internationale sur les conditions et l'évolution de l'enseignement de la chimie, Greystones, Irlande, 29 février - 10 mars 1960. *Pour un nouvel enseignement de la chimie.* Paris, OCDE, 1961. 230 p.

Le but principal de la Session d'étude a été de dégager des conclusions quant aux mesures précises à prendre pour jeter les bases d'un programme qui réponde mieux, sur le plan intellectuel aussi bien que sur le plan pratique, aux exigences de la chimie moderne.

1961

Organization for Economic Cooperation and Development, Paris. *Policy for school science; countries with special problems of basic educational development, report of the Seminar, Istanbul, 14-23 September 1961.* Paris, 1962. 93 p. (Science and education for the future)

Taking as a basis of discussion the five main subjects dealt with by the previous OECD Conference (Brussels, 1960), namely: development of sciences and mathematics curricula; equipment and teaching materials, recruitment and training of teachers; the role of industry in the development of technical and scientific education; school guidance and talent search; the Istanbul conference unanimously recommended that the science curriculum be considered within the framework of a general plan of education and not in isolation from the other subjects, and that permanent bureaus of planning and statistics, and of coordination and advice, be created within the ministries of education.

Organisation de Cooperation et de Développement Economiques, Paris. *Politique à suivre en matière d'enseignement scientifique, rapport sur la Session d'études organisée par le Bureau du personnel scientifique et technique de l'OECE, Istamboul, 14 au 23 septembre 1961.* Paris, 1962. 95 p. (OCDE, Science et éducation pour l'avenir).

Reprenant comme base de discussion les cinq principaux thèmes de la conférence de Bruxelles (1960) - amélioration des programmes de sciences et mathématiques, équipement et matériel pédagogiques, recrutement et formation des maîtres, rôle de l'industrie dans le développement de l'enseignement scientifique et technique, et orientation scolaire et recherche des talents - la Conférence d'Istamboul à unanimement conclu à la nécessité de concevoir les plans d'études scientifiques non pas isolément des autres matières, mais bien dans le cadre d'un programme global d'éducation et de créer, au sein de chaque Ministère de l'éducation, deux services permanents: l'un de planification et de statistique, l'autre de coordination et d'orientation.

1962

OECD Seminar on the Reform of Biology Teaching, La Tour de Peilz (near Vevey, Switzerland) 4-14 September 1962. *New thinking in school biology, report on the OECD Seminar.* Paris, OECD, 1963. 328 p. (New thinking in school science)

A seminar of participants representing 20 countries wherein problems of school biology education were discussed. The discussion centered on the following topics: the case for reform of biology teaching, new approaches to curricula, school biology in O.E.C.D. countries, problems of implementation.

Colloque international de l'OCDE sur la réforme de l'enseignement de la biologie, La Tour de Peilz, 4-14 septembre 1962. *Pour un nouvel enseignement de la biologie, rapport du Colloque.* Paris, OCDE, 1963. 374 p.

Des représentants de 20 pays ont participé à ce Colloque, consacré aux problèmes posés par l'enseignement de la biologie dans les écoles. Les débats ont porté sur: la nécessité d'une réforme de l'enseignement de la biologie; une nouvelle conception des programmes; l'enseignement de la biologie dans les pays de l'OCDE, et les problèmes de mise en oeuvre d'une telle réforme.

Seminar on the Teaching of Basic Sciences in African Universities, Rabat, 13 to 22 December 1962. *The teaching of sciences in African universities, report of the seminar.* Paris, Unesco, 1964. 112 p.

A Unesco meeting for participants from nineteen English, French, and Arabic speaking countries of Africa who were actively engaged in the teaching of basic sciences in African universities. "The purpose of the seminar was to examine problems related to the teaching of mathematics, physics, chemistry, biology, and geology at the university level, with special emphasis on African needs."

Convoqué par l'Unesco, ce Colloque a réuni des participants provenant de dix-neuf pays africains de langue anglaise, française et arabe, tous intéressés directement à l'enseignement des sciences fondamentales dans les universités d'Afrique. Le projet du colloque était d'examiner les problèmes concernant l'enseignement, au niveau universitaire, des disciplines suivantes: mathématiques, physique, chimie, biologie et géologie, dans l'optique particulière des besoins de l'Afrique.

A Study Seminar held at the Unesco Youth Institute, May 11th to 16th, 1962. *The physical and natural sciences.* Gauting, Youth Institute, 1963. 33 p. mimeo.

The fourth in a series of seminars on "How to make youth better acquainted with the modern world". Discussions concentrated on "ways of awakening in young people an interest in the natural and physical sciences and in methods of scientific investigation".

Quatrième colloque d'une série de réunions consacrées à l'adaptation de la jeunesse au monde moderne. Les débats ont porté sur les moyens d'amener les jeunes à s'intéresser aux sciences physiques et naturelles ainsi qu'aux méthodes de la recherche scientifique.

1963

Expert Conference held at the University of Ceylon, Peradeniya, December 1963. *School science teaching, report [of the conference]* London, Her Majesty's Stationary Office, 1964. 140 p.

Recognizing that "a rapid improvement of science education is essential for accelerating economic development and for enabling the individual citizen to understand something of the complexities of an increasingly technological age," this Conference took stock of the present state of school science teaching in the Commonwealth countries and examined resources for expanding and improving school science teaching.

Reconnaissant qu'une amélioration urgente de l'enseignement des sciences est essentielle pour accélérer le développement économique et faire comprendre aux hommes certaines questions complexes posées par l'essor extraordinaire de la technologie, cette conférence a fait le point de la situation actuelle de cet enseignement dans les pays du Commonwealth et le bilan des moyens qui permettront de le développer et de l'améliorer.

O.E.C.D. Working Session on the Teaching of School Chemistry, London, July 1963. *School chemistry, trends in reform, selected topics, report [of the session]* Paris, OECD, 1963. 94 p. (New thinking in school science)

While taking stock of developments in school chemistry through country reports presented by 15 countries, this London session aimed also at providing stimulus to national efforts through sharing of information on new developments in teaching methods and materials.

Session d'étude organisée par l'OCDE à Londres en juillet 1963. *Chimie scolaire, évolution de la réforme, nouvelles présentations, rapport d'une session.* Paris, OCDE, 1964. 96 p.

Les participants ont fait la synthèse des rapports provenant de 15 pays et montrant l'évolution de la réforme de la chimie scolaire; ils se sont efforcés ensuite d'encourager les efforts nationaux par l'échange de documentation sur les méthodes et le matériel d'enseignement.

1964

Meeting of Science and Mathematics Teachers of Special Fund Colleges, Abidjan, 2-11 July 1964. *The teaching of science and mathematics.* Accra, Unesco Regional Centre for Educational Information and Research in Africa. (Occasional paper no. 3)

Collection of papers presented at the Meeting, gathered by the Accra centre for distribution restricted to the Special Fund colleges.

Réunion des professeurs de sciences et de mathématiques des Ecoles normales supérieures du Fonds spécial, Abidjan 2-11 juillet 1964. *L'enseignement des sciences et des mathématiques.* Accra, Centre régional de l'Unesco pour l'information et la recherche pédagogiques en Afrique, 1965, 84 p. (Publication spéciale no. 3)

Recueil des documents présentés au cours de cette réunion, publié par le Centre d'Accra à l'intention exclusive des écoles normales supérieures du Fonds spécial.

1964 (Cont'd) / (Suite)

OECD Working Session on the Teaching of School Biology, Hellebaek (Denmark) 22nd-27th June 1964. *Biology today, its role in education,* report of /the OECD Session/ prepared by Paul Duvigneaud, English version ed. by M.L.C. Comber. Paris, OECD, 1966.

A follow-up of the OECD seminar held in Switzerland in 1962 "to underline the function of biology as an important element of contemporary culture, and consequently, the place of biology teaching in a school curriculum based upon a contemporary scientific humanism. The Session concentrated on three aspects of modern biological thought - the ecological, the genetical and the physiological". Guidelines were formulated for writers of school biology manuals, for the training and retraining of teachers, and for equiping field studies and laboratory work.

Session d'étude organisée par l'OCDE sur la réforme de l'enseignement de la biologie. Hellebaek (Danemark) 22-27 juin 1964. *Biologie moderne, son rôle dans l'éducation,* rapport d'une session... par le Professeur Paul Duvigneaud et M.L.C. Comber. Paris, OCDE, 1966. 174 p.

Cette session d'études fait suite au colloque tenu en Suisse en 1962 et qui a eu pour but de souligner le rôle de la biologie en tant qu'élement important de la culture contemporaine, et de montrer, par conséquent, la place de l'enseignement de la biologie dans un programme d'études fondé sur un humanisme scientifique contemporain. Les participants ont concentré leur attention sur trois aspects de la biologie moderne: l'aspect écologique, l'aspect génétique et l'aspect physiologique. Ils ont formulé des conseils en ce qui concerne la rédaction de manuels scolaires de biologie, la formation et le perfectionnement des maîtres, et l'équipement nécessaire pour les travaux sur le terrain et en laboratoire.

1966

First Asian Regional Conference on School Biology, December 1966, Manila, Philippines. *Proceedings of the first conference on school biology education.* Manila, Asian Association for Biology Education, 1967. 349 p.

Concerned about the "serious imbalance between population needs and material resources" in Asia and recognizing that through biology education answers to this problem may be sought, biology educators of the region met for the first time to examine the present aims of biology teaching and criteria for the selection of course content; teaching methods and teacher training; evaluation in school biology teaching; relation of school biology to post-school biology and everyday life; the role of the universities and other agencies in school biology; and country reports on school biology.

Préoccupés par l'énorme disproportion existant entre les besoins des populations d'Asie et les ressources dont elles disposent , et convaincus que l'enseignement de la biologie peut aider à résoudre ce problème, des spécialistes de l'enseignement de la biologie ont tenu cette première conférence afin de discuter les thèmes suivants: les objectifs actuels de l'enseignement de la biologie et les critères à suivre pour en arrêter le contenu; les méthodes d'enseignement et la formation des maîtres; les rapports entre la biologie à l'école et après l'école, et la vie quotidienne; le rôle des universités et des autres institutions en faveur de l'enseignement de cette discipline à l'école. Ils ont également pris connaissance de rapports nationaux sur l'état actuel de la question.

1967

International Conference on High School Chemical Education, August 28 to September 2, 1967, Washington D.C. *International chemical education: the high school years: proceedings of the Conference sponsored by the American Chemical Society.* Washington, D.C., 1968. 135 p. illus.

Realizing that much could be gained through person-to-person discussions, this conference, at which organizations and institutions from nine countries were represented, met to share new ideas, compare progress, and study in detail approaches to the teaching of chemistry. This report includes in the appendixes a list of some programmed materials in high school chemistry and addresses of science education projects.

Les échanges de vues directs de personne à personne présentant de grands avantages, cette conférence, à laquelle ont participé des représentants de divers organismes et institutions de neuf pays, a été convoquée afin de permettre de partager des idées nouvelles, de comparer les progrès accomplis, et d'étudier de façon approfondie les diverses manières de concevoir l'enseignement de la chimie. En annexe à ce rapport, une liste de matériel didactique programmé pour l'enseignement supérieur de la chimie et les adresses des responsables d'expériences en matière d'enseignement des sciences.

Meeting of Officers of the Teaching Commissions of the International Scientific Unions in the Basic Sciences to Advise on Unesco's Programme in Science Teaching. Paris, 8-10 March 1967. *Final report.* Paris, 1967. 1 v. (various paging) (SC/CS/25/1) Distribution limited.

A consensus on guidelines for Unesco's policy on science teaching which cover the following: criteria of Unesco science teaching activities, role of science teaching advisers to Unesco, a basic programme for Unesco's Department of Science Teaching for the next few biennia, continual revitalization of the teaching profession, the role of research and science education, stimulation of public interest in and understanding science.

Recueil de principes directeurs concernant la politique de l'Unesco en matière d'enseignement des sciences et portant sur les points suivants: règles de conduite de l'Unesco dans le domaine de l'enseignement des sciences; rôle des conseillers de l'Unesco en matière d'enseignement scientifique; bases des prochains plans biennaux du Département de l'enseignement des sciences de l'Unesco; encouragement permanent de la profession enseignante; rôle de la recherche et l'enseignement des sciences; moyens propres à susciter l'intérêt et la compréhension à l'égard de la science.

Science Teaching in a World Perspective, [theme of the conference, at University of Sussex, 2-8 April 1967]

A conference of Commonwealth Bursars sponsored by the Federal Education and Research Trust and the World Association of World Federalists. A paper on "*The Role of the Science Teacher in Developing Countries*" was presented by the Science Education Office, London.

Une étude sur *le rôle du professeur de sciences dans les pays en voie de développement* a été presentée par le Science Education Office de Londres au cours de cette Conférence qui regroupait des administrateurs d'établissements d'enseignement du Commonwealth sous le patronage du Federal Education and Research Trust et du Mouvement universel pour une fédération mondiale.

1968

Congress on the Integration of Science Teaching / Congrès sur l'intégration des enseignements scientifiques, Droujba (Bulgarie) 11-19 Septembre 1968. Paris, CIES /1968/ 74 p.

Initiated by the International Council of Scientific Unions with the support of Unesco, The Ford Foundation and other national agencies, the Congress studied the possible development of courses in integrated science and discussed ways of organizing the teaching of the subject as a coherent whole, particularly at the secondary level. The theme being large-integration of science with social science, physchology, and economics had to be omitted. As a basis for the discussion the terms integration and coordination were defined; and issues concerning the teaching of science, activities of the pupils, content of an integrated course, and teaching methods were considered to justify the attempt to introduce integrated science courses.

Organisé par le Conseil international des unions scientifiques, avec le concours de l'Unesco, de la Fondation Ford et de divers organismes nationaux, le congrès à d'abord défini les termes coordination et intégration. Il a ensuite étudié les possibilités d'intégration des enseignements scientifiques et discuté des meilleurs moyens de les organiser, principalement au niveau secondaire, en un tout cohérent, Enfin, ayant examiné divers aspects du problème tels que les méthodes d'enseignement, l'activité de l'élève, et le contenu d'un cours intégré, le congrès a conclu à la justification de l'intégration des enseignements scientifiques. Vu l'ampleur du sujet, l'intégration avec les sciences sociales, la psychologie et l'économie politique n'a pu être abordée.

Intergovernmental Conference of Experts on the Scientific Basis for Rational Use and Conservation of the Resources of the Biosphere, Unesco House, Paris, 4-13 September 1968. *Final Report.* Paris, Unesco, 1969. 19 p. (SC/MD/9)

Considering the accelerated deterioration which is taking place in man's present environment, Unesco organized and convened a conference with the assistance of appropriate organizations of the UN family and other interested international bodies. Experts from thirty Unesco Member States participated and formulated recommendations dealing with the use and conservation of the resources of the biosphere. Recommendations 8-12, and 16 advocate science programmes and activities which should be urgently carried on by educational and research institutions.

A l'origine de cette conférence organisée par l'Unesco avec le concours d'autres membres de la famille des Nations Unies et d'autres organismes internationaux intéréssés, se trouve la préoccupation causée par la détérioration croissante du milieu géographique de l'homme. Les délégués de trente Etats membres de l'Unesco, à l'issue de leurs discussions, ont approuvé des recommandations concernant l'utilisation et la conservation des ressources de la biosphère. Les recommandations 8 à 12, et 16, préconisent l'urgente mise en oeuvre, par les organismes de recherche et les établissements d'enseignement, de programmes et d'activités appropriés, de caractère scientifique.

International Coordinating Committee for the Presentation of Science and the Development of Out-of-School Scientific Activities. *Report of the meetings and resolutions of the world General Assembly, Brussels, 8 to 11 October 1968.* Brussels, 1968. 1 v. (various paging)

1968 (Cont'd) / (Suite)

The meeting considered administrative matters for maintaining its programmes and debated on special themes, including: "Problems set by the creation and development of out-of-school science activities in the developing countries."

Le Comité a examiné les moyens administratifs nécessaires à l'exécution de ses programmes, ainsi que des sujets particuliers tels que les problèmes posés par l'instauration et la mise en oeuvre, dans les pays en voie de développement, d'activités scientifiques extra-scolaires.

International Workshop on Evaluation of Chemistry Courses at School Level, Peradeniya, University of Ceylon, 13-18 August 1968. *Report* (in preparation)

Organized by the IUPAC Committee on the Teaching of Chemistry and sponsored by the Ministry of Education, Ceylon and Unesco; and attended by eleven countries, the Workshop followed-up the IUPAC report on "The Effect of Examinations in Determining Chemistry Curricula." Deliberations were centered also on the constructing and administration of chemistry examinations to produce desired effects on the teaching of chemistry within an educational system.

Organisé par le Comité pour l'enseignement de la chimie de l'Union internationale de chimie pure et appliquée (UICPA), avec le concours du Ministère de l'éducation de Ceylan et de l'Unesco; des délégués de onze pays y ont participé. Ce stage d'étude fait suite au rapport de l'UICPA sur "l'influence des examens sur l'élaboration des programmes de chimie". Les discussions ont porté sur la manière de concevoir et de faire passer les examens en vue d'orienter dans le sens voulu l'enseignement de la chimie dans un système scolaire donné.

Leverhulme Conference on Science Education in Africa, Chancellor College, University of Malawi, 25th-30th March 1968. *Report.*

The sixth of a series of inter-university conferences on African education sponsored by the Leverhulme Trust. The papers and the discussions dealt with five main topics: psychological and sociological factors in science education; factors involved in the acquisition of science concepts in Africa; objectives and methods of science teaching in emergent societies; illustrative approaches to the teaching of science in Africa; problems of evaluation of science courses.

Sixième réunion d'une série de conférences inter-universitaires sur l'éducation en Afrique, patronnée par le Leverhulme Trust. Les documents et les débats ont porté notamment sur cinq sujets principaux: aspects psychologiques et sociologiques de l'enseignement des sciences; conditions d'acquisition des notions scientifiques en Afrique; objectifs et méthodes de l'enseignement des sciences dans les pays depuis peu indépendants; des modèles de méthodes d'enseignement des sciences en Afrique; les problèmes d'évaluation des cours de sciences.

Panel of experts on Nuclear Science Teaching. *Nuclear science teaching-report of the panel... jointly convened by the IAEA and Unesco, Bangkok, 15-23 July 1968.* Vienna, International Atomic Energy Agency. 1968. 21 p. (Technical reports ser. no. 94)

The Panel representing 14 countries discussed country programmes and adopted various recommendations for improving nuclear science teaching.

Le groupe d'experts (réprésentant 14 pays) a examiné un certain nombre de programmes nationaux et a formulé diverses recommandations touchant l'amélioration de l'enseignement de la science nucléaire.

Second Asian Regional Conference on School Biology Education, August 11 - 17, 1968, Mitaka, Tokyo, Japan. *Report* (in preparation)

Attended by 40 foreign delegates representing 13 Asian countries, the conference assessed the extent to which recommendations made in previous conferences had been implemented, identified problems in implementing recommendations, explored specific aspects of applied biology of significance to secondary school biology, and acquainted participants with mass media techniques in the teaching of biology.

Quarante délégués réprésentant treize pays d'Asie ont participé à cette conférence. Après avoir recherché dans quelle mesure les recommandations issues des conférences antérieures avaient été suivies, ils ont défini les problèmes à résoudre en ce domaine. Ils ont ensuite examiné certains aspects de la biologie appliquée qui intéressent l'enseignement de la biologie dans les écoles secondaires, et se sont informés de l'emploi des techniques et moyens modernes d'information par les professeurs.

1969

Conference on the Application of Science and Technology to the Development of Asia, New Delhi, 9-20 August 1968. *Final report.* Part I. *Conclusions and Recommendations.* Paris, Unesco, 1969. 36 p. (SC/MD/Part I)

A Conference attended by participants from 25 countries to "consider action required to further the application of science and technology to the development of Asia". Chapter III of Part I deals with "Improvement of science education in the countries of Asia".

Conférence sur l'application de la science et de la technique au développement de l'Asie, New Delhi, 9-20 août 1968. *Rapport final. Partie I. Conclusions et Recommandations.* Paris, Unesco, 1969. 39 p. (SC/MD/11)

Cette conférence, à laquelle ont participé des délégués venus de 25 pays, a eu pour but de rechercher les mesures à prendre pour assurer l'application de la science et de la technologie au développement des pays d'Asie. Le chapitre III de la première partie est consacré à l'amélioration de l'enseignement des sciences dans ces pays.

Regional Workshop on Unesco/UNICEF-Assisted Projects in Science Education in Asia, Bangkok, 4-18 November 1968. *Planning for science teaching improvement in Asian schools; final report.* Bangkok, Unesco Regional Office for Education in Asia, 1969. 34, xxv p.

The deliberations centred on the need for a reform in science teaching in schools, proceeding from an analysis of the existing programmes. Certain principles relevant to the conditions in the Asian region were identified, and recommendations were made relating to the existing projects. Two chapters deal with the preparation of new project designs and procurement and maintenance of equipment.

Les débats ont porté sur la réforme indispensable de l'enseignement des sciences dans les écoles, à partir d'une analyse des programmes en vigueur. Certains principes découlant des conditions particulières à l'Asie ont été formulés, ainsi que des recommandations touchant les projets en cours d'exécution. Deux chapitres sont consacrés l'un à la préparation de nouveaux projets, l'autre aux problèmes d'achat et d'entretien du matériel scientifique.

Planning Meeting for Unesco's Programme in Integrated Science Teaching, Unesco, Paris, 17-19 March 1969. *Final report.* Paris, 1969. 27 p. (SC/MD/13)

A meeting of scientists and educators which reviewed current efforts to improve science teaching at the primary and lower secondary levels, and proposed a strategy for implementing Unesco's programme in integrated science teaching which has among its activities: issue of publications, technical services to Member States, experimental projects for development of new teaching methods and materials, and workshops.

Réunion d'hommes de science et d'enseignants qui, après avoir passé en revue les efforts actuellement déployés pour améliorer l'enseignement des sciences dans les écoles primaires et les écoles secondaires du second cycle, ont proposé un programme de l'Unesco en matière d'enseignement intégré des sciences. Ce programme prévoit, entre autres activités, l'édition de diverses publications, l'offre de services techniques aux Etats membres, l'exécution de projets expérimentaux visant à la mise au point de méthodes et de matériel pédagogiques nouveaux, ainsi que l'organisation de stages d'études.

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NOTES ON ASIAN DOCUMENTS ON EDUCATION

NOTES SUR DES DOCUMENTS DE PAYS D'ASIE CONCERNANT L'EDUCATION

The following brief annotated list of documents on education has been compiled by a selection from entries in recent quarterly Accession Lists of the Unesco Regional Office Library (available to readers).

La courte liste annotée de documents sur l'éducation ci-dessous a été établie d'après une sélection de références dans les listes trimestrielles récentes des acquisitions de la bibliothèque du Bureau régional de l'Unesco.

Afghanistan. Ministry of Education, Planning Department. *Education in Afghanistan during the last fifty years: Vol. 1. Primary, secondary and vocational education.* Kabul, 1968. 258 p. 59 tables.

First volume of a comprehensive two-volume presentation of education of the country. Chapters cover historical development of education, the educational situation today, problems of educational development, the Third Plan and long term prospects, and foreign aid programmes. A good source for statistical data and a bibliography on the country's education.

C'est le premier volume d'une étude en deux tomes donnant une vue d'ensemble de l'éducation du pays. Les chapitres traitent de l'évolution historique, de la situation actuelle et des problèmes du développement de l'éducation; du Troisième plan et de ses possibilités à long terme; et des programmes d'assistance extérieure. Cet ouvrage est une bonne source de données statistiques et de renseignements bibliographiques sur la situation de l'enseignement du pays.

Anuman Rajadhon, Phya. *Essays on Thai folklore.* Bangkok, The Social Science Association Press of Thailand, 1968. 383 p.

Published on the 80th birthday of the author as a tribute to this well known scholar and authority on Thai culture. The contents cover essays on culture, language and literature, folktale, the Buddhistic rites and rituals. Added to the essays is a selection, "The life of the farmer" translated and edited by William J. Gedney.

Ouvrage publié en honneur de l'auteur, une autorité en matière de civilisation thailandaise, à l'occasion de son 80e anniversaire. Le livre contient des essais sur la civilisation, la langue et la littérature; sur les contes et légendes du pays Thai, et sur les rites et cérémonies de la réligion boudhique; et en plus une sélection, *"The life of the farmer"* (la vie du fermier), traduite et éditée par William J. Gedney.

Basu, C. K. *Programmed instruction in industries, defence, health and education.* New Delhi, Indian Association for Programmed Instruction, 1969. 72 p.

Six articles and five research studies on programmed learning are presented for their implication for teaching-learning situations in industry, defence, health, and education. Included also are addresses for information on programmed learning and a selected bibliography.

Six articles et cinq études sur l'enseignement programmé, présentés en raison de leur incidence sur les procédés d'enseignement dans l'industrie, la défense nationale, la santé et l'éducation. L'ouvrage comprend également une liste d'adresses à l'intention de ceux qui voudraient avoir des renseignements sur l'enseignement programmé, ainsi qu'un choix bibliographique.

International Conference on Educational Research in Asia and the Southern Pacific (Third) Manila, June 24-29, 1968. *Educational research and national development, proceedings and working papers*, ed. by Aurelio O. Elevazo. Manila, 1969. 290 p.

A report of a conference organized as a sequel to the conferences held in Japan in 1959 and in Thailand in 1963. The discussions centered on: (1) Educational research and educational planning, (2) Educational research and manpower development, (3) Educational research and the curriculum, and (4) International co-operation in educational research. The last chapter of the report entitled, "After the conference, what?" is a plea "for a practical program of action" or "action research", pointing to the kind of studies which may be undertaken, by whom and with what funds, equipment, and facilities, and suggestions for the use of the results of the studies.

Le rapport d'une conférence qui fait suite à celles qui eurent lieu au Japon en 1959 et en Thaïlande en 1963. Les discussions portèrent sur: (1) La recherche pédagogique et la planification de l'éducation, (2) La recherche pédagogique et le développement des ressources humaines, (3) La recherche pédagogique et les programmes et plans d'études, et (4) La coopération internationale et la recherche pédagogique. Le dernier chapitre du rapport, intitulé *"After the Conference, what?"* ("Et après la Conférence?") est une plaidoirie en faveur d'un "programme pratique d'action", ou "de recherche opérationnelle", signalant quels programmes pourraient être mis à l'oeuvre, par qui et avec quels fonds, quel équipement et quels moyens, et suggérant l'emploi qu'on pourrait faire des résultats de ces programmes.

International Labour Organisation. Regional Office for Asia, Bangkok. *I.L.O. technical co-operation activities in Asia during 1968.* Bangkok, 1969. 63 p.

A report of technical co-operation programmes, regional activities, and 17 Asian country projects including those of the South and Western Pacific areas.

Un rapport sur les programmes de coopération technique, les activités régionales, et les projets concernant 17 pays asiatiques, y compris les pays du sud et de l'ouest du Pacifique.

Japan Audio-Visual Information Center for International Service and Japan Audio-Visual Education Association. *Audio-visual education in Japan 1969.* Tokyo, Japan Audio-Visual Education Association, 1969. 59 p.

The latest edition of the title showing how audio-visual materials are used for educational purposes in Japan. Illustrated with statistics and photographs of actual classroom use of a-v materials.

Dernière édition de cet ouvrage, montrant l'emploi qu'on fait au Japon, à des fins pédagogiques, du matériel audiovisuel. L'ouvrage contient des illustrations et donne des statistiques sur l'emploi du matériel audiovisuel à l'école.

Komai, Hiroshi. *Changing pattern of Japanese attitudes toward work: a consequence of recent high economic growth.* Tokyo, Institute of Population Problems, Ministry of Health and Welfare, 1969. 35 p. (English pamphlet series, no. 67). mimeo.

A paper presented at the Second Regional Seminar on the Sociology of Development held in Delhi, India from November 25 to December 20, 1968 and organized by the Research Center on Social and Economic Development in Asia, Institute of Economic Growth, Delhi.

The problem of labour shortage is studied through an analysis of changing pattern of employment status, industrial relations, effect of technological innovation, and widening scope of Japanese life.

Reference is made to the fact that while young workers have traditionally been welcomed as a supply for cheap labour, the demand for high school graduates is now three times larger than the supply.

Document de travail présenté au second Séminaire régional sur la sociologie du développement qui s'est tenu à la Nouvelle Delhi, Inde, du 25 novembre au 20 décembre 1968, et organisé par le *Research Centre on Social and Economic Development in Asia, Institute of Economic Growth,* Delhi. (Centre de recherches sur les problèmes du développement économique et social, Institut du développement économique, Delhi.)

Le problème de la pénurie du travail y est étudié par l'analyse de la structure changeante du statut de l'emploi, par celle des relations industrielles, de l'effet des innovations technologiques, et des possibilités croissantes de la vie japonaise.

Le document fait état du fait que, traditionnellement il était bien vu de disposer des jeunes travailleurs comme source de main d'oeuvre à bon marché, alors qu'aujourd'hui la demande de jeunes de fin du secondaire est trois fois plus grande que l'offre.

La Salle, Frank P. *Young Farmer Clubs of Ceylon, a report.* Bangkok, FAO, 1969. 22 p. mimeo.

To revitalize the Young Farmers Club Movement, the Minister of Agriculture and Food of Ceylon requested a review of the Movement's programme and activities; this is the report which also includes recommendations for strengthening such a Movement.

Afin de revivifier le *Young Farmers Club Movement* (Le Mouvement pour les clubs de jeunes fermiers), le Ministère de l'agriculture et l'alimentation de Ceylan a fait faire un examen des programmes et des activités du Mouvement; en voici le rapport, qui donne en outre des recommandations pour le renforcement du Mouvement.

Malaysia. Ministry of Education. The Educational Planning and Research Division. *Education in Malaysia.* Kuala Lumpur, Dewan Bahasa Dan Pustaka, Kementerian Pelajaran Malaysia, 1968. 96 p.

A first compilation which, according to the foreword by H. E. the Minister of Education Mohd. Khr. Johari, "will prove very enlightening to teachers, parents, administrators and all those who seek to understand the 'Whys', 'Whats' and 'Wherefors' of education in Malaysia."

Première compilation qui, selon la préface de Son Excellence M. le Ministre de l'éducation, Mohd. Khr. Johari, "ne manquera pas d'éclairer les enseignants, les parents, les administrateurs et tous ceux qui essayent de comprendre les raisons, le contenu et les buts de l'éducation en Malaisie."

Seminar on Books and National Development April 27-29, 1968, Academy House, Seoul. *Report.* Seoul, Korean Publishers Association /1968/ 110 p.

A record of the papers and discussions of the 3-day international seminar sponsored by the Korean Library Association to instil the importance and role of books as a tool for national development. Contains substantial statistical figures of the Korean publishing industry gathered from various sources.

Compte rendu des documents de travail et des discussions d'un stage d'études de trois jours patronné par le Korean Library Association (Association bibliothécaire de Corée), et destiné à montrer l'importance et le rôle des livres en tant qu'instrument de développement national. Ce rapport donne des renseignements statistiques substantiels, fournis par différentes sources, sur l'industrie du livre en Corée.

South Pacific Commission. *Directory of youth organizations in the South Pacific.* Noumea, New Caledonia, 1968. 68 p.

A directory to 112 youth organizations located in 14 countries or territories in the South Pacific. Each organization is covered by the following information: address, date of establishment, membership, aims, activities, leadership, finance and publications.

Répertoire de 112 organisations de jeunes situées dans 14 pays ou territoires du Pacifique du Sud, et caractérisées par les informations suivantes: adresse, date de fondation, nombre de membres, buts, activités, fonction dirigeante, finances, et publications.

Teachers' Training College. T.T.C. Publications Board, Singapore. *The teacher begins.* Singapore, 1969. 63 p. (TTC Publication. Texts in teacher education).

The first in the series of "Texts in Teacher Education" covering the art, science or discipline of teaching or education. The appendix contains charts of the Singapore educational system (1968) and the emerging pattern of education, 1969.

Premier ouvrage de la série *"Texts in Teacher Education"* (Cahiers pédagogiques) portant sur l'art, science ou discipline de l'enseignement ou l'éducation. L'appendice contient un organigramme du système actuel de l'éducation à Singapour (1968) et les structures nouvelles pour 1969.

/SEAMEC/ Regional Seminar on the Teacher Education Program Tryout at the SEAMEC Regional English Language Centre, Singapore, 31 October-2 November 1968. *Report.* Singapore, SEAMEC Regional English Language Centre, 1969. 202 p.

An evaluation by a seminar group which met for three days to study the "tryout" Teacher Education Program (TEP) which was held from February to November 1968 for teachers who train teachers of English as a second language. A description and the content of TEP are given including administrative aspects for supporting the program.

Evaluation faite par un stage d'études réuni pendant trois jours pour étudier le "programme d'essai" du *Teacher Education Programme, TEP* (Programme de formation d'enseignants), lequel s'est tenu du février à novembre 1968 à l'intention des enseignants chargés de la formation des professeurs d'anglais en tant que seconde langue. Le rapport donne la description et la substance du TEP et indique les moyens administratifs servant de support au programme.

/Thailand/ National Seminar on Education for International Understanding, Strividhaya School, Bangkok, June 10-14, 1968. *Records of the national seminar.* Bangkok, Thailand National Commission for Unesco, 34 p. 1969.

A report summarizing the proceedings and the general discussions. Noteworthy of mention are the illustrations and discussions on study kits and the Recommendations adopted by the Seminar.

Rapport donnant un aperçu des débats et des discussions générales. Sont à retenir les illustrations et discussions sur des collections de documents pédagogiques, ainsi que les recommandations adoptées par le stage d'études.

Unesco-NIER Regional Programme for Educational Research in Asia. *Asian study on curriculum development, research design and questionnaires,* compiled by R. H. Dave. Tokyo, National Institute for Educational Research, 1969. 69 p.

A brochure containing a research design and questionnaires worked out by participants of an Educational Research Workshop for carrying out national and cross-national comparative studies which are expected to be completed in 1970. It is hoped that the brochure will also be of use to those concerned with research on curriculum development.

Brochure présentant un modèle de recherche et des questionnaires préparés par les participants au stage d'études régional, et destinés à servir aux travaux de recherche à l'échelon national qui seraient complétés en 1970. On espère que cette brochure sera utile à ceux qui entreprennent de la recherche sur le développement des plans et programmes d'études.

World Student Christian Federation. *The relevance of the social sciences in contemporary Asia: university teachers in dialogue.* Tokyo, 1968. 182 p.

A report of a conference in Japan in 1967, which incorporates the thinking of social scientists on issues confronting present-day Asian society and the role university teachers must take to enable academic ideas to meet the demands of society. As university teachers participate in the research and planning projects of their respective countries, a major portion of the report deals with national planning.

Le rapport d'une conférence tenue au Japon 1967, comprenant la pensée des spécialistes en sciences sociales qui ont discuté des problèmes afférant à la société asiatique contemporaine, et du rôle que les professeurs d'université doivent jouer pour permettre à la pensée universitaire de faire face aux demandes de la société. Etant donné que les professeurs d'université participent à la recherche et à la planification dans leur propre pays, une grande partie de l'ouvrage est consacrée à la planification à l'échelon national.

CONFERENCES, MEETINGS, SEMINARS ON EDUCATION

Tentative Calendar

5-12 Aug.	New Delhi	Seminar of Experts on University Teaching for Educational Planning (AIEPA)
1 Sept. - 31 Jan. 1970	New Delhi	10th Training Course for Educational Planners and Administrators (AIEPA)
9-16 Sept.	Bangkok	Preparatory Meeting of Experts for Third Regional Conference of Ministers of Education in Asia (in collaboration with ECAFE)
15 Sept. - 10 Oct.	Paris	Executive Board of Unesco: 83rd Session
23 Sept. - 3 Oct.	Quezon City	Regional meeting on curriculum development in teacher education in Asia (AITE)
4-11 Oct.	Colombo	Sub-regional Seminar on Education Development and its Effects on School Building Design (ARISBR)
4-28 Oct.	Colombo	Development Group Training Course for Groups from Ceylon, East Pakistan, Cambodia, Nepal and one individual from Afghanistan (ARISBR)
20-28 Oct.	Paris	Joint FAO/ILO/Unesco International Advisory Committee on Agricultural Education, Science and Training (Jointly with FAO/ILO) (1st session)
18 Oct. - 7 Nov.	Tokyo	Follow-up Workshop on Mathematics Teaching in Asia (NIER)
October	Geneva	Meeting of experts on wastage at all levels of education
27 Oct. - 9 Nov.	Isphahan	Study visit to the Iran Experimental Literacy Project

17-21 Nov.	Hamburg	Seminar for Directors of Educational Research (Unesco Institute for Education, Hamburg)
December	Tokyo	Meeting of the Co-ordinating Committee for the Comparative Study of Curriculum Development (NIER)
1970		
8 Jan. - 22 April	Quezon City	Fifth Institute for Key Teacher Educators (AITE)
February	Paris	Meeting of experts to examine studies on education and development
March - April	Teheran (?)	Regional Conference of Asian National Commissions (convened by National Commission host country)
27 April - 8 May	Paris	ILO/Unesco Joint Committee on the application of the Recommendation concerning the status of teachers
April	Bangkok	Working group on the teaching of physics
July	Geneva	International Conference on Public Education (32nd session)

Note: Certain initials above refer to the following institutions:

AIEPA - Asian Institute of Educational Planning and Administration (sponsored by Unesco)

AITE - Asian Institute for Teacher Educators (sponsored by Unesco)

ARISBR - Asian Regional Institute for School Building Research (sponsored by Unesco)

NIER - National Institute for Educational Research, Japan

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Vol. I, No. 1, September 1966

Review of educational progress in the Asian Region
Some major trends – first, second, third levels of education – girls' education – public expenditure on education – abstracts of country progress reports – charts – statistical supplement and bibliography.

Vol. I, No. 2, March 1967

The problem of educational wastage at the first level
Magnitude – different groups, urban and rural areas – repetition and dropouts – causes and implications of wastage – measures for combatting wastage – review of selected studies and surveys – charts and tables.

Vol. II, No. 1, September 1967

Widening horizons of education in the Asian Region
Recent developments in education in a number of Asian countries.

Vol. II, No. 2, March 1968

Educational research in the Asian Region
Development of major educational research institutions/bureaux/organizations in Asian countries – review of selected research programmes.

Vol. III, No. 1 September 1968

Organization of educational planning in the Asian Region
General review and chapters on each of 19 Asian Countries. Organigrams, plans, and financing in some instances.

Vol. III, No. 2, March 1969

General secondary school curriculum in the Asian Region
Expansion – social and economic development – major subject areas – evaluation and examinations – tables and articles for Asian countries.

Recent issues contain a bibliographical supplement.

BANGKOK